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Sakurai et al.

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(54) IMAGE PROCESSING METHOD, IMAGE PROCESSING APPARATUS AND IMAGE PROCESSING PROGRAM

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(51) **Int. Cl.**[7] **G06K 9/40**; H04N 5/225
(52) **U.S. Cl.** **382/266**; 348/207.99
(58) **Field of Search** 382/173, 190, 382/255, 260, 264, 266, 275, 284, 312; 348/207.99, 348/208.99, 208.4; 358/3.26, 533; 396/52

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(57) **ABSTRACT**

An image processing method includes the steps of obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other, and a control step for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound when the blur control is performed to the second image.

17 Claims, 13 Drawing Sheets

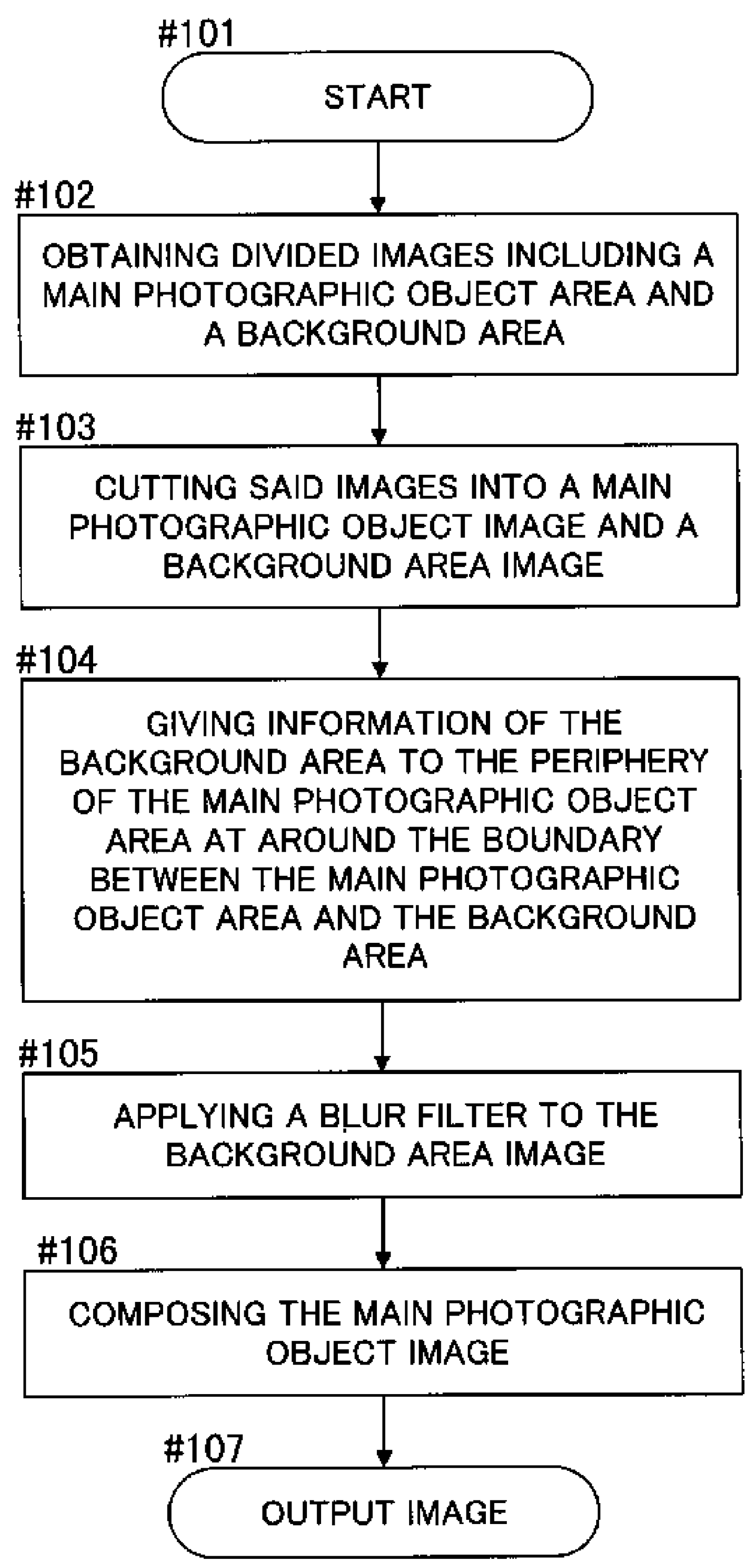


FIG. 1
(PRIOR ART)

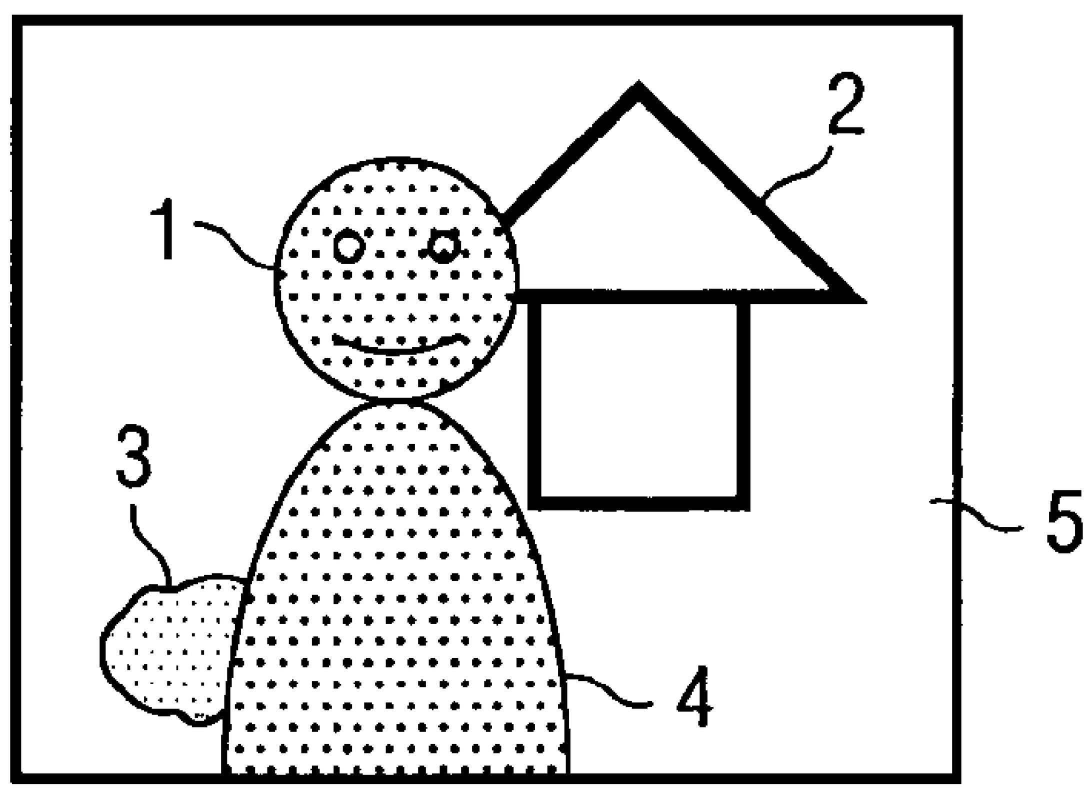


FIG. 2
(PRIOR ART)

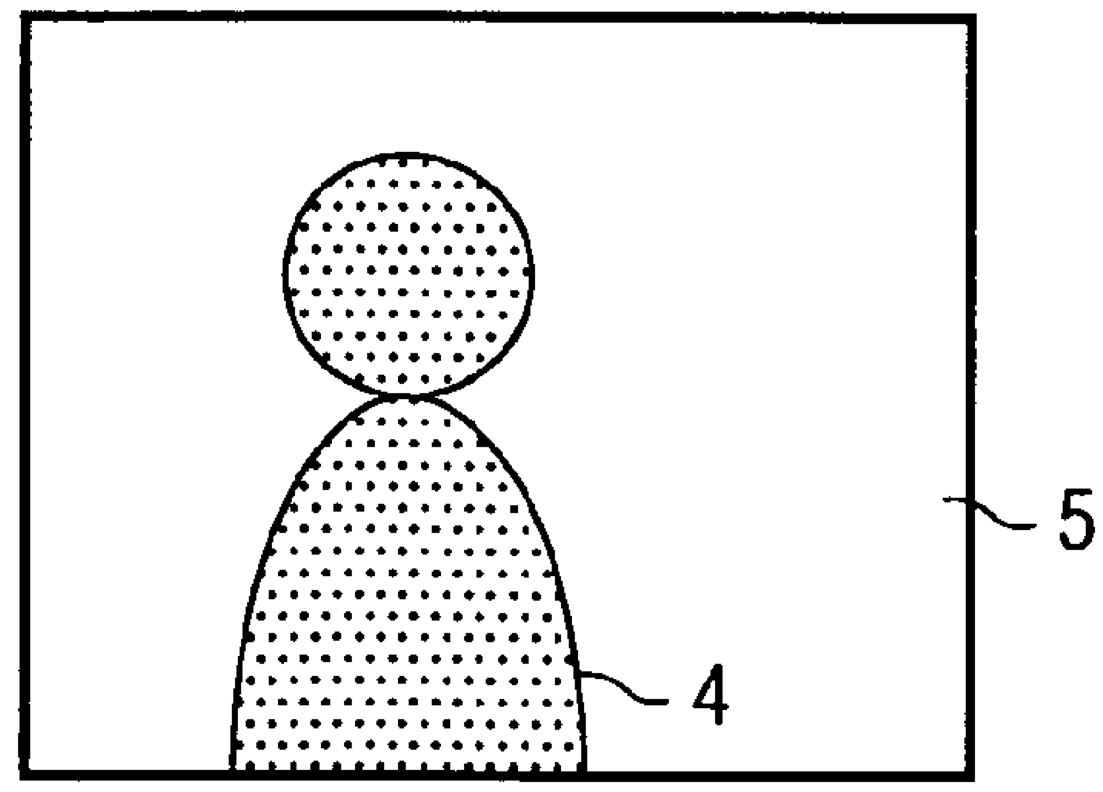


FIG. 3A
(PRIOR ART)

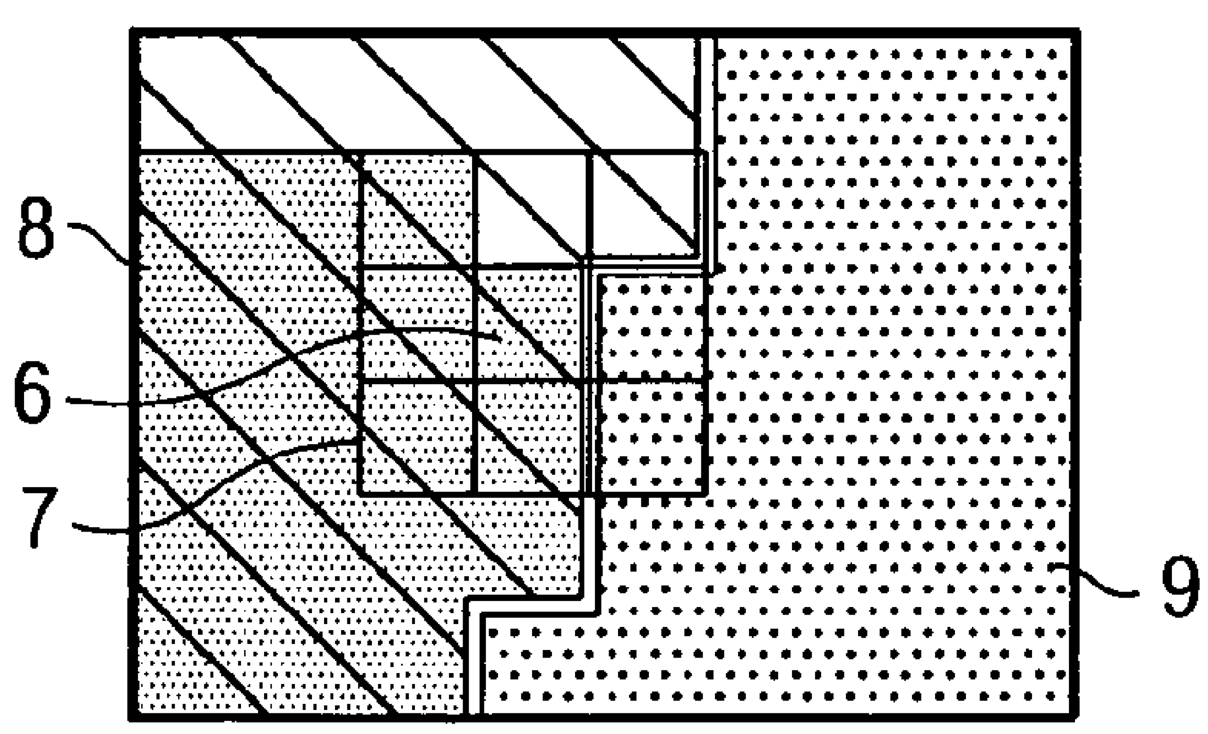


FIG. 3B
(PRIOR ART)

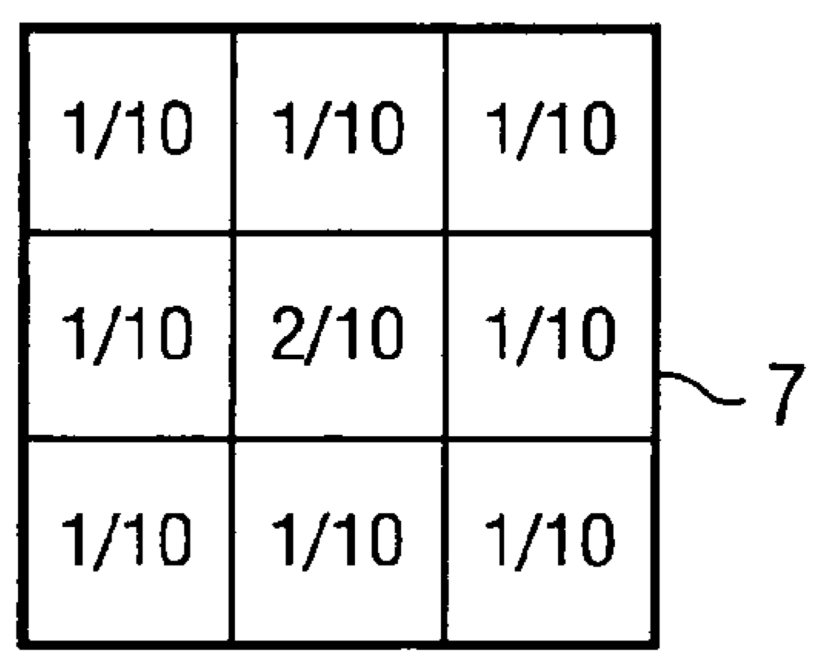


FIG. 3C
(PRIOR ART)

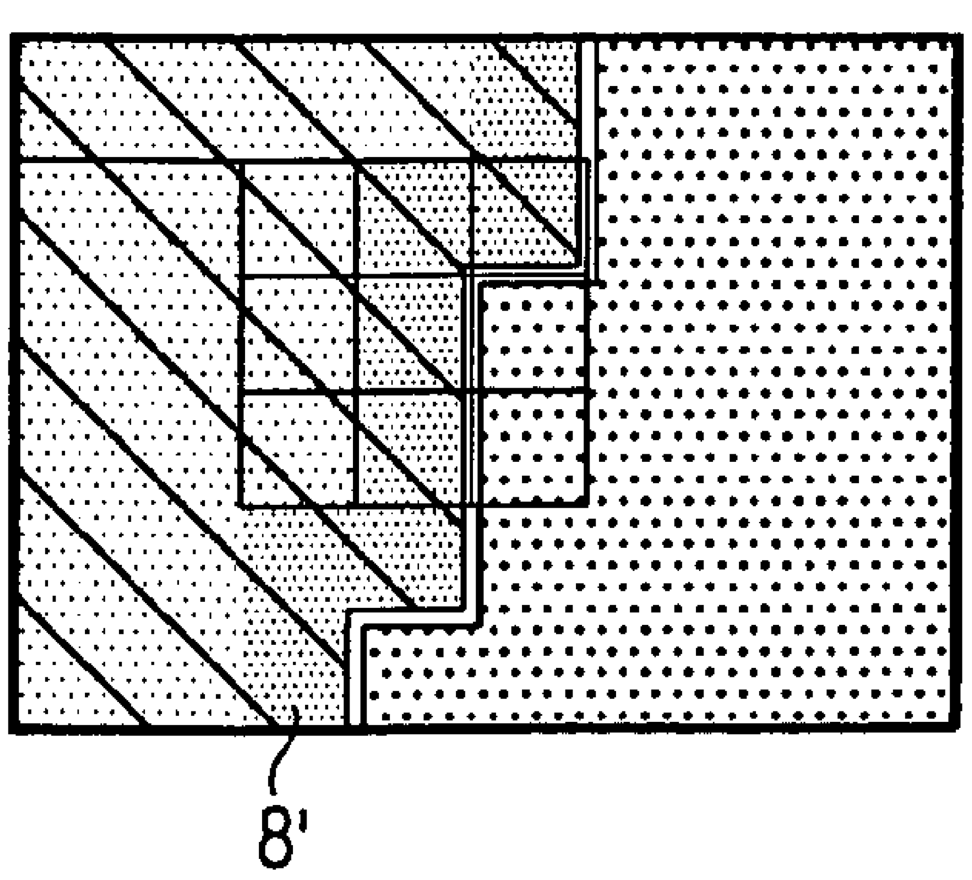


FIG. 4A
(PRIOR ART)

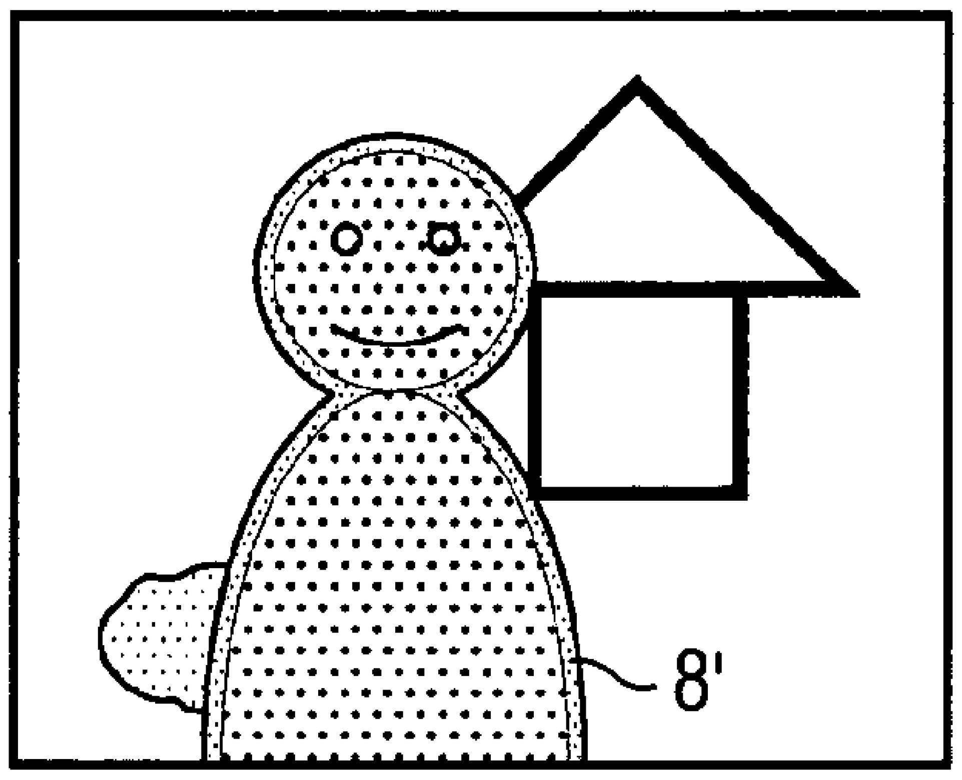


FIG. 4B
(PRIOR ART)

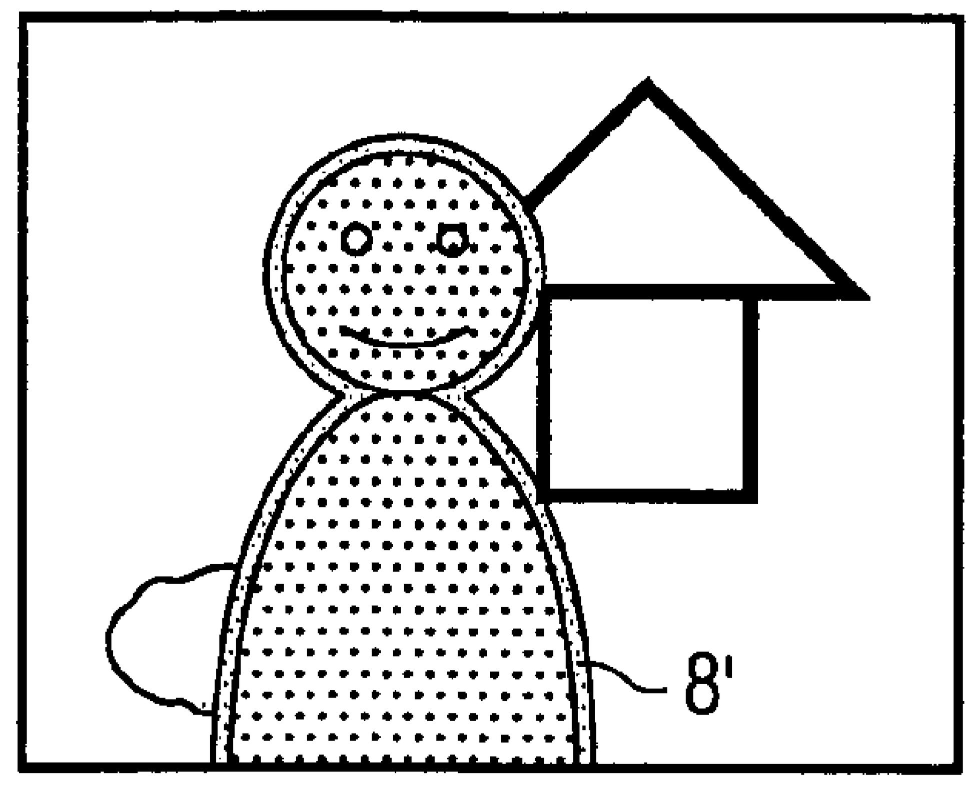


FIG. 5A

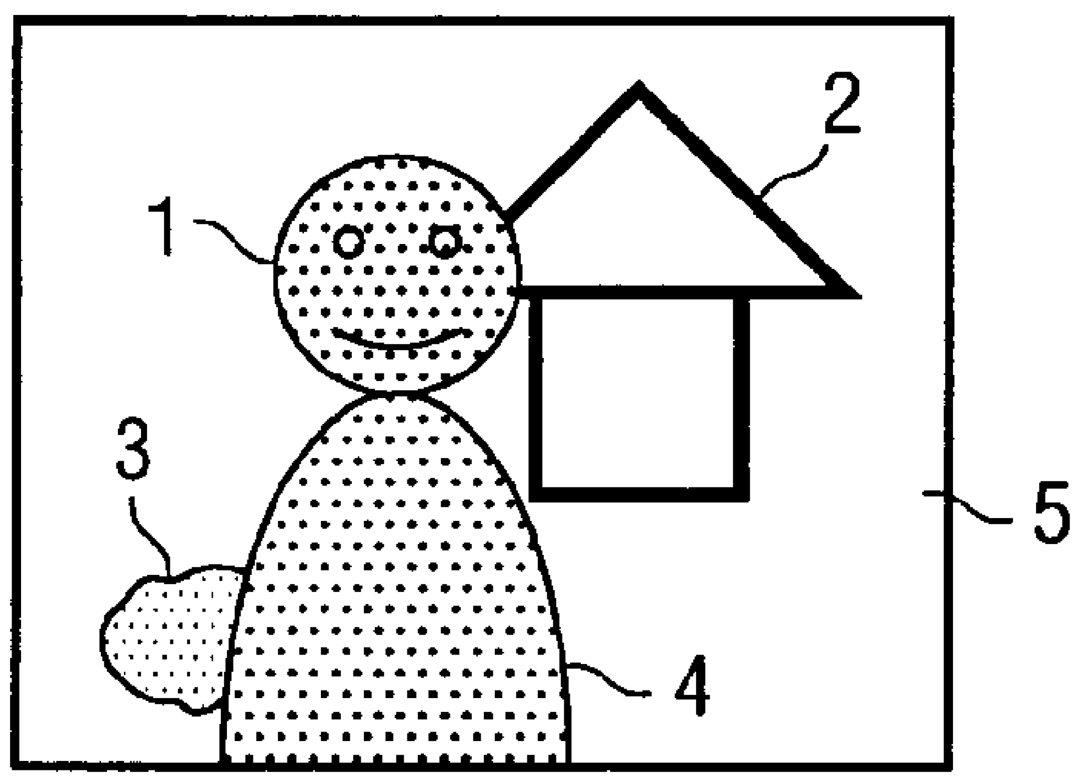


FIG. 5B

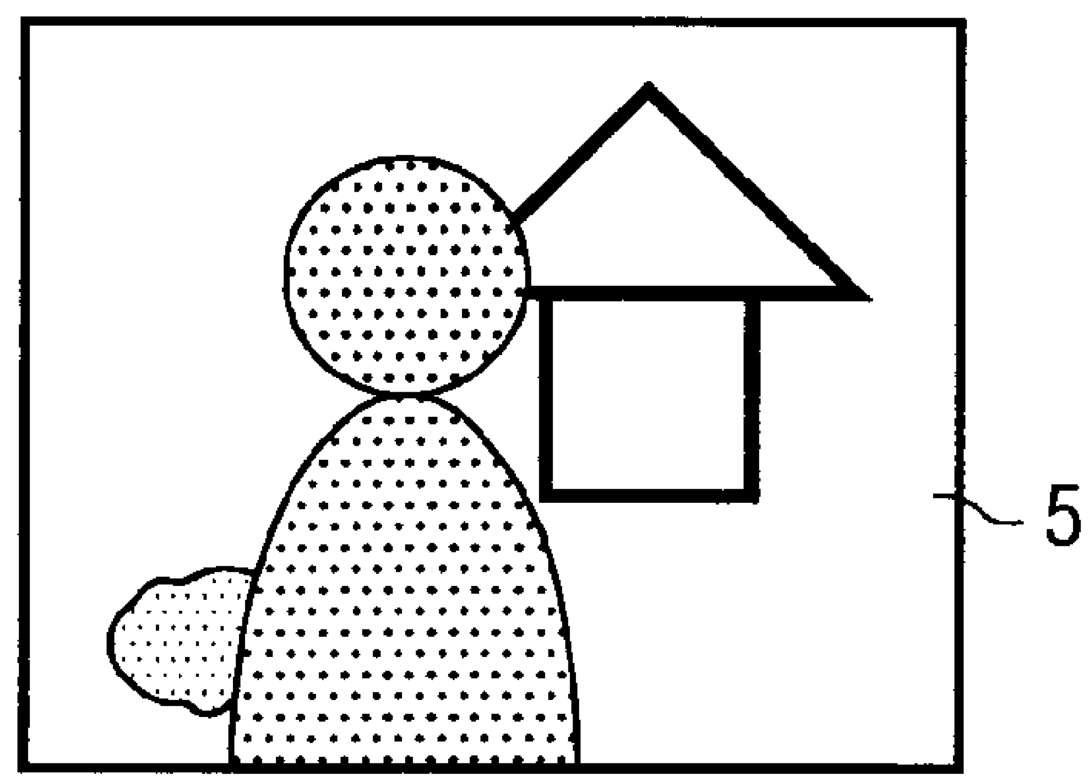


FIG. 5C

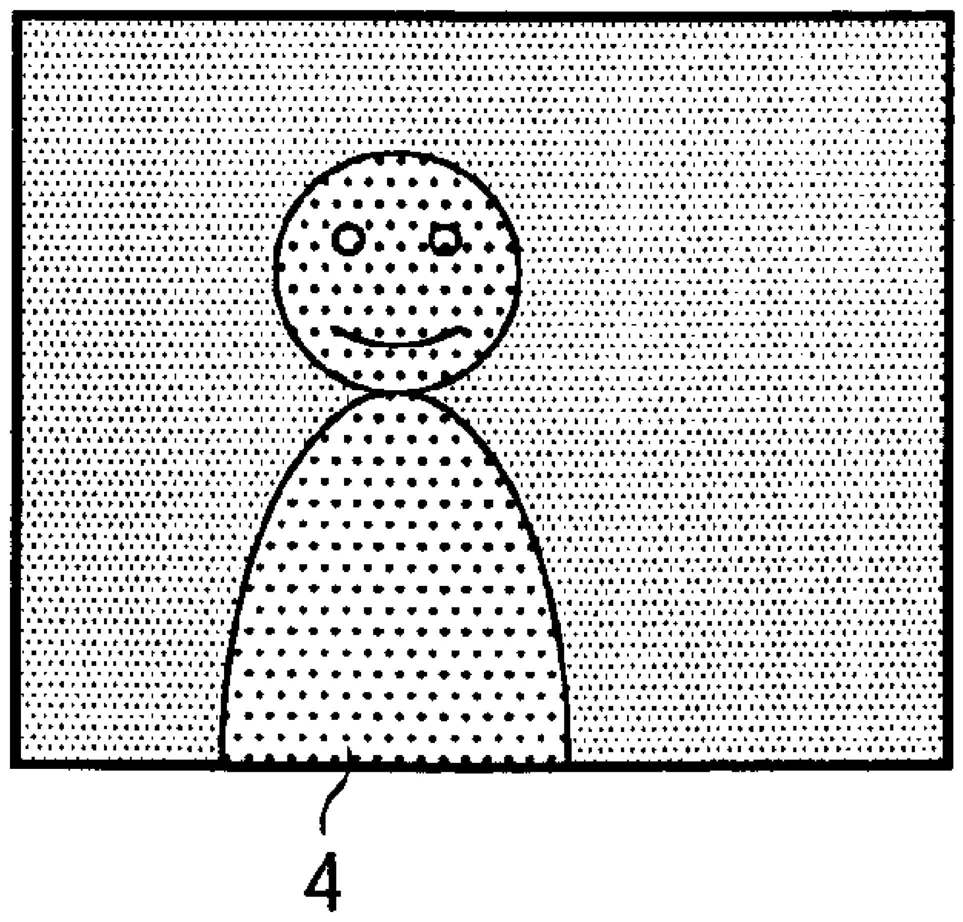
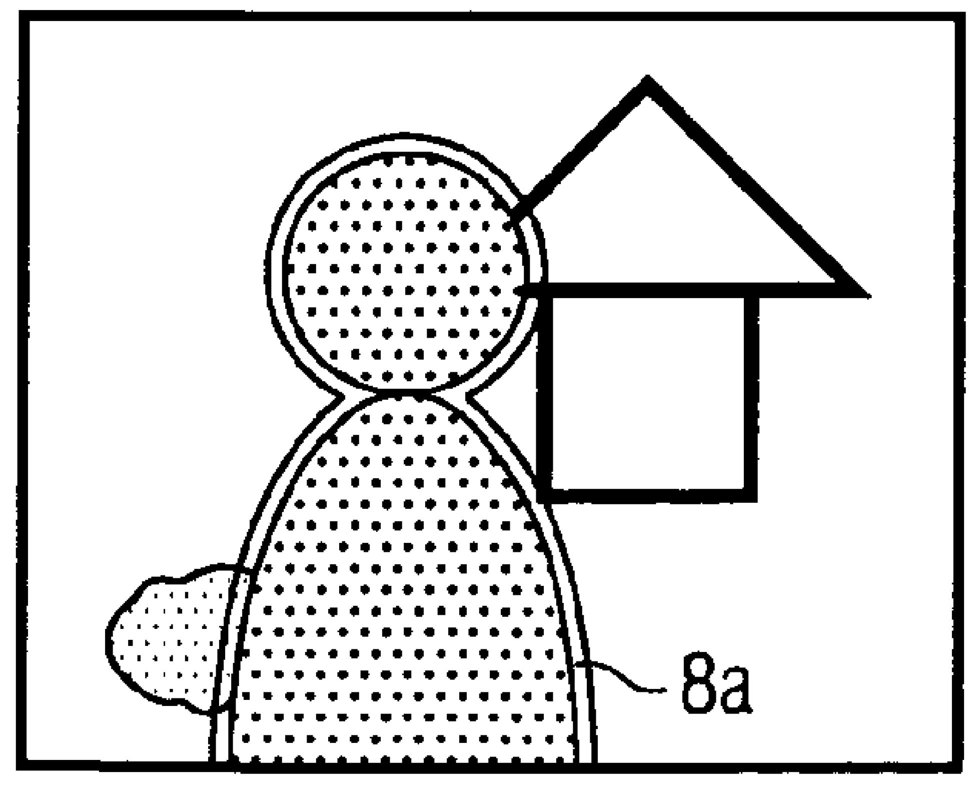


FIG. 6



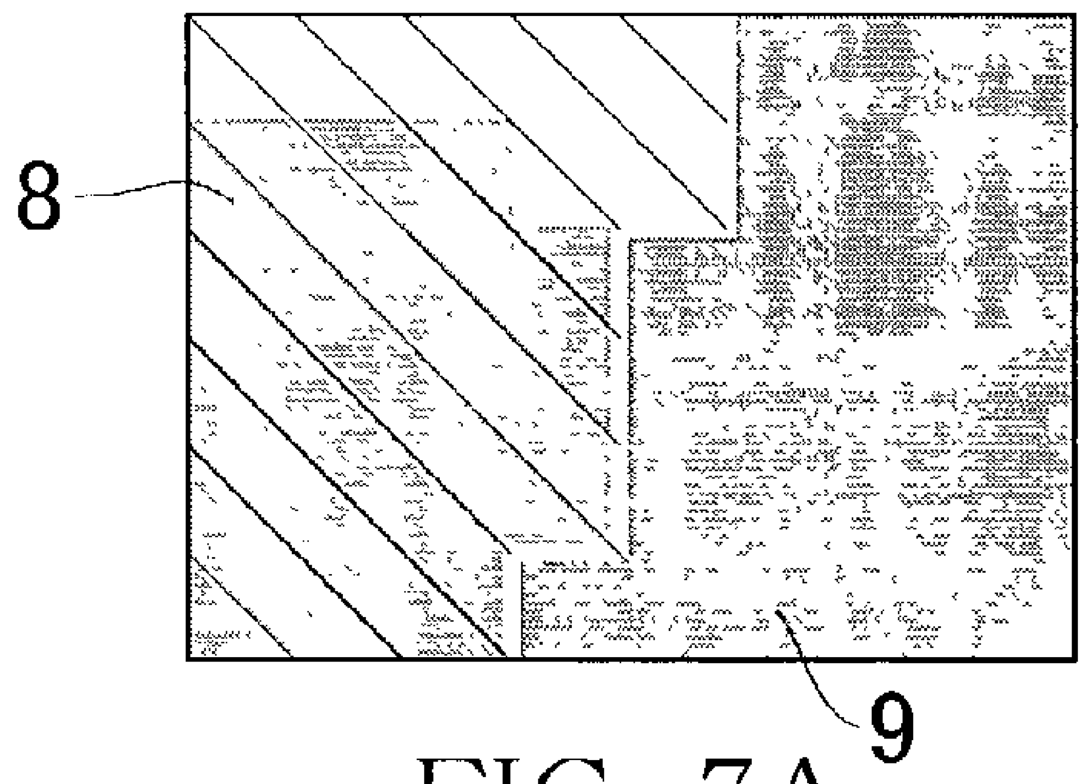


FIG. 7A

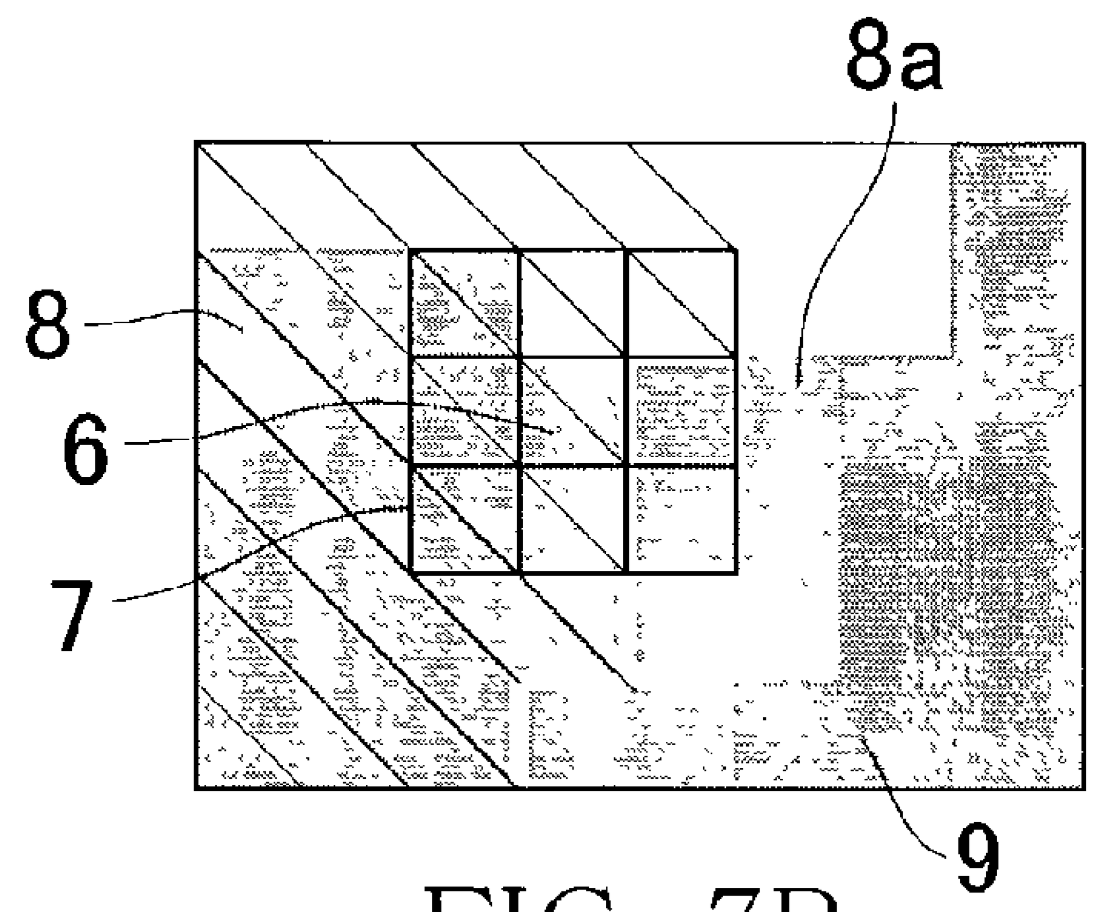


FIG. 7B

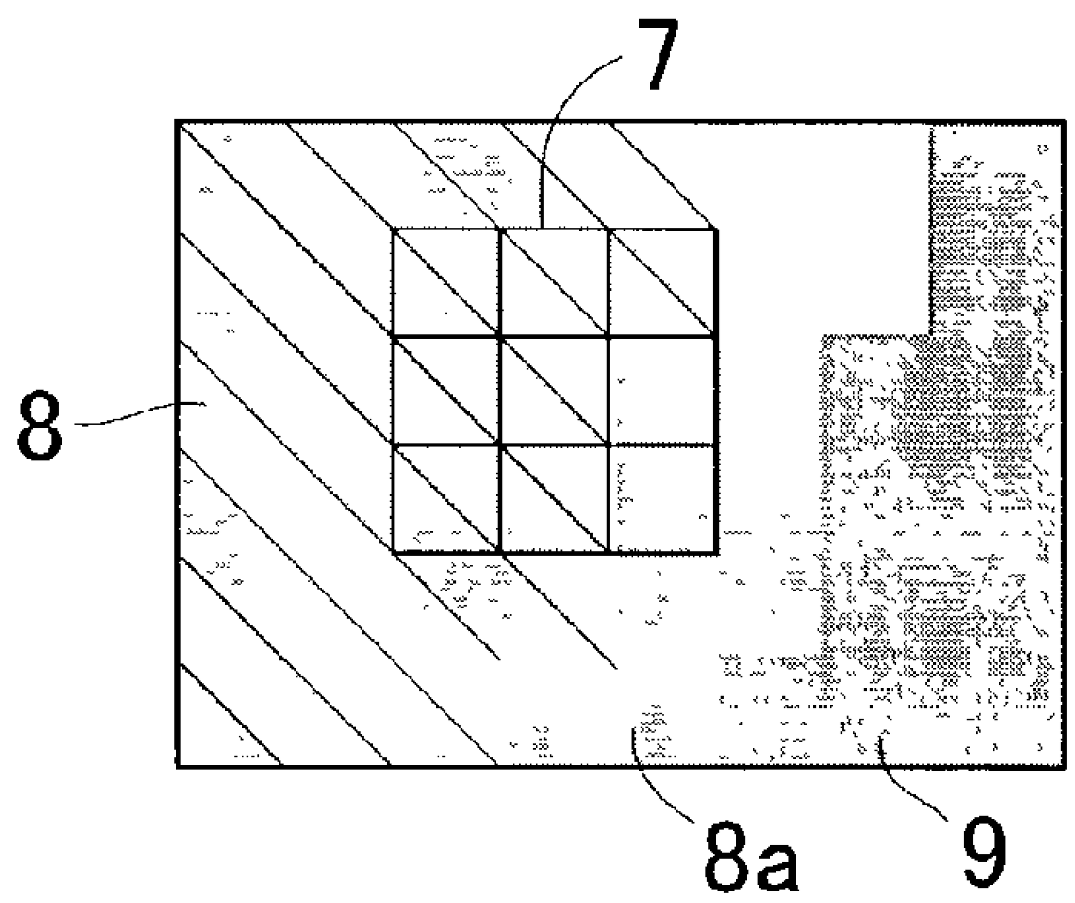


FIG. 7C

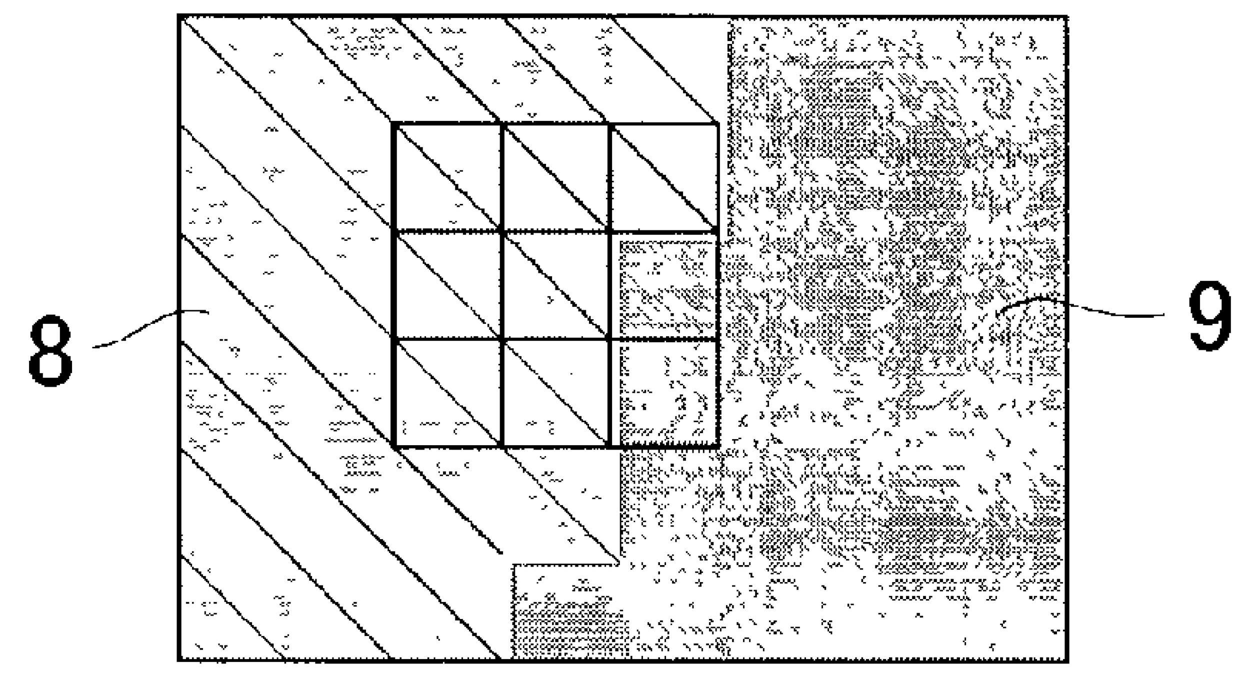


FIG. 7D

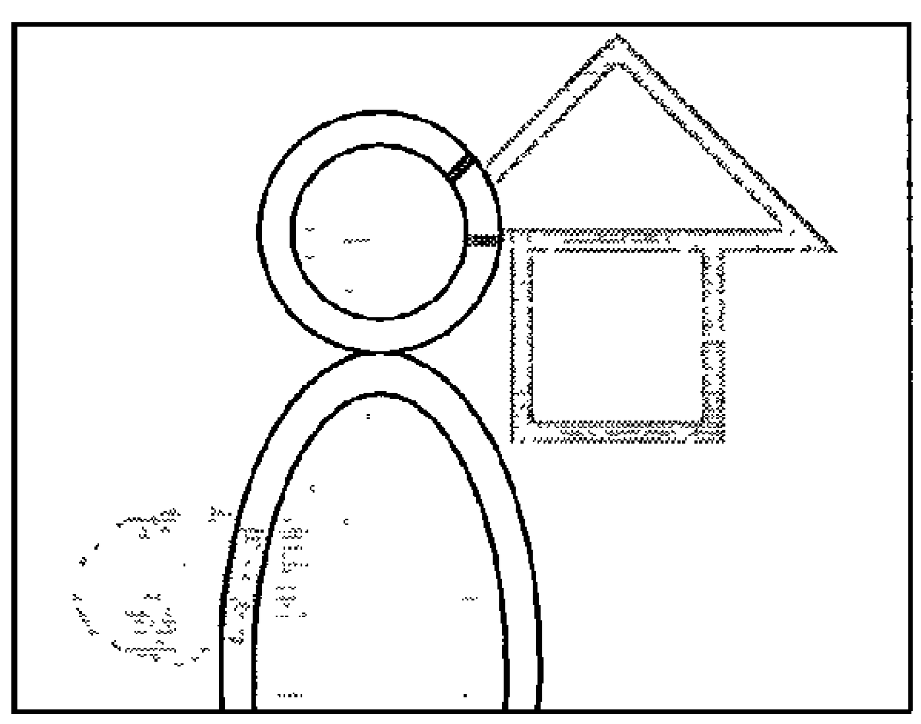


FIG. 8

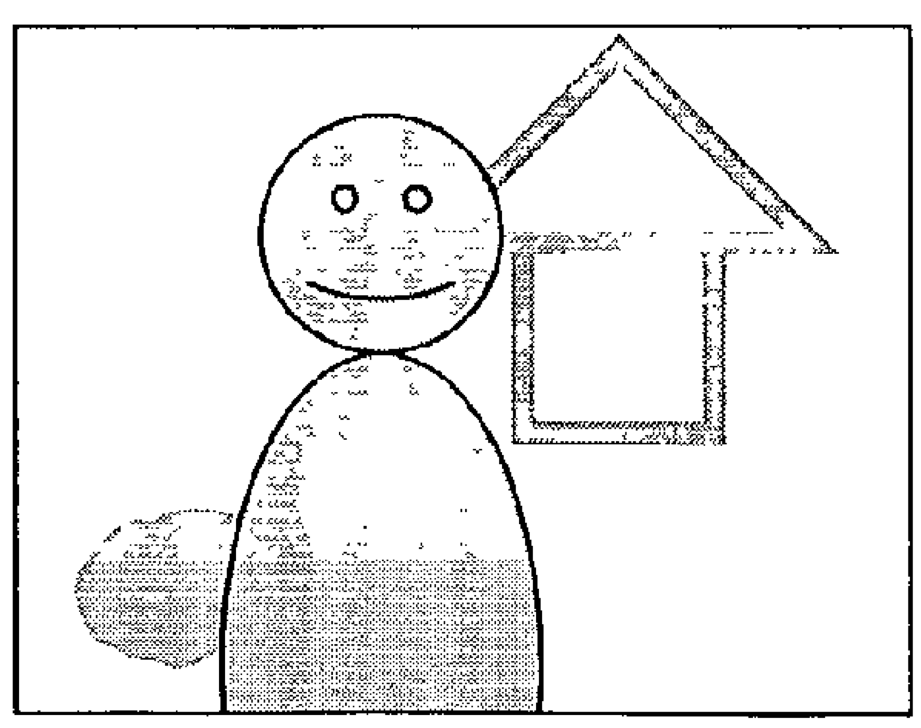


FIG. 9

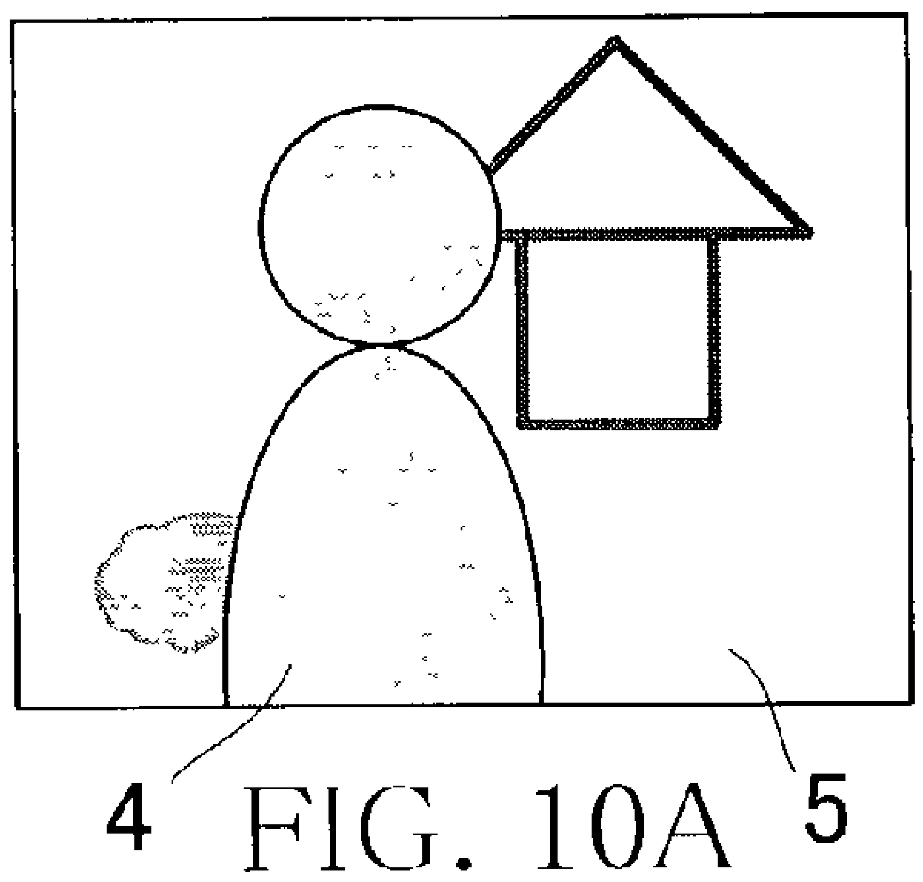


FIG. 10A

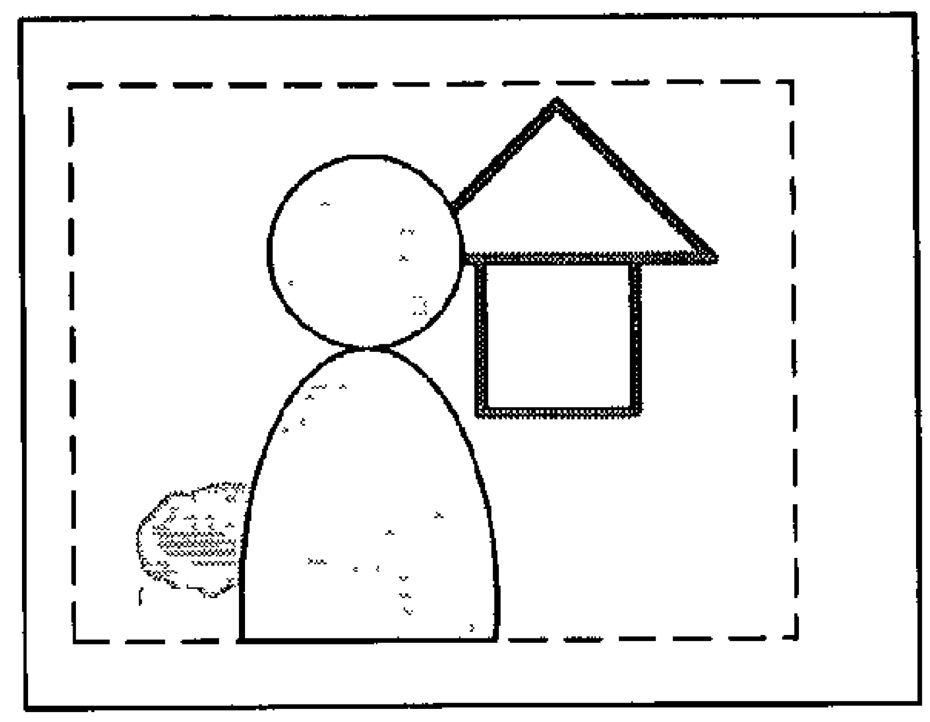


FIG. 10B

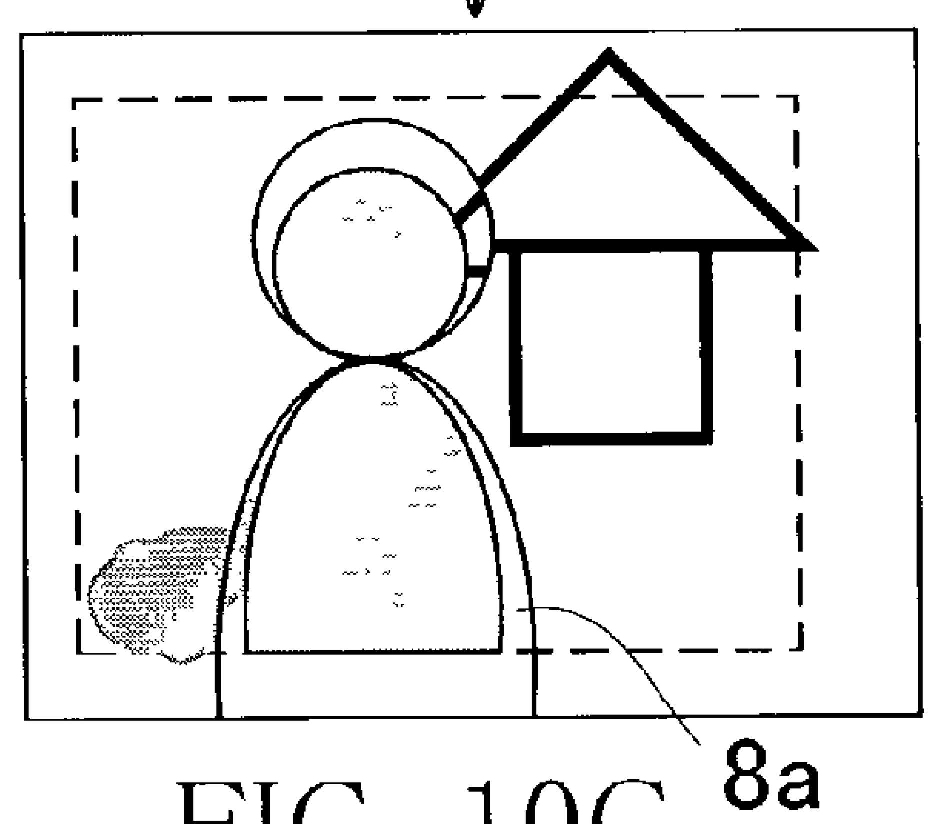


FIG. 10C

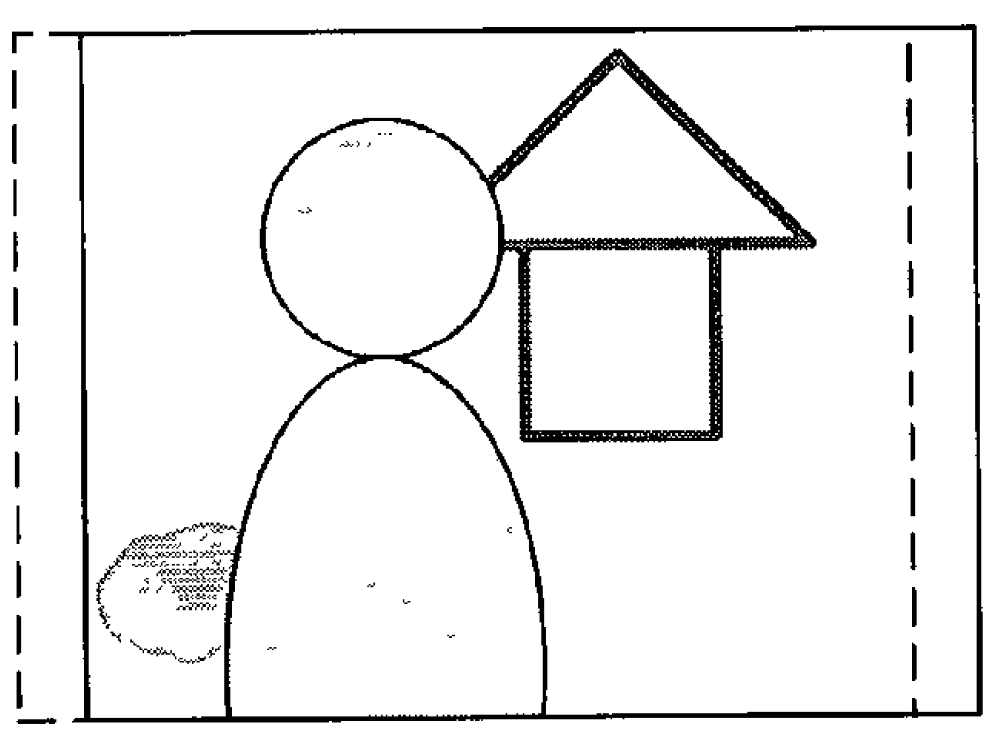


FIG. 10D

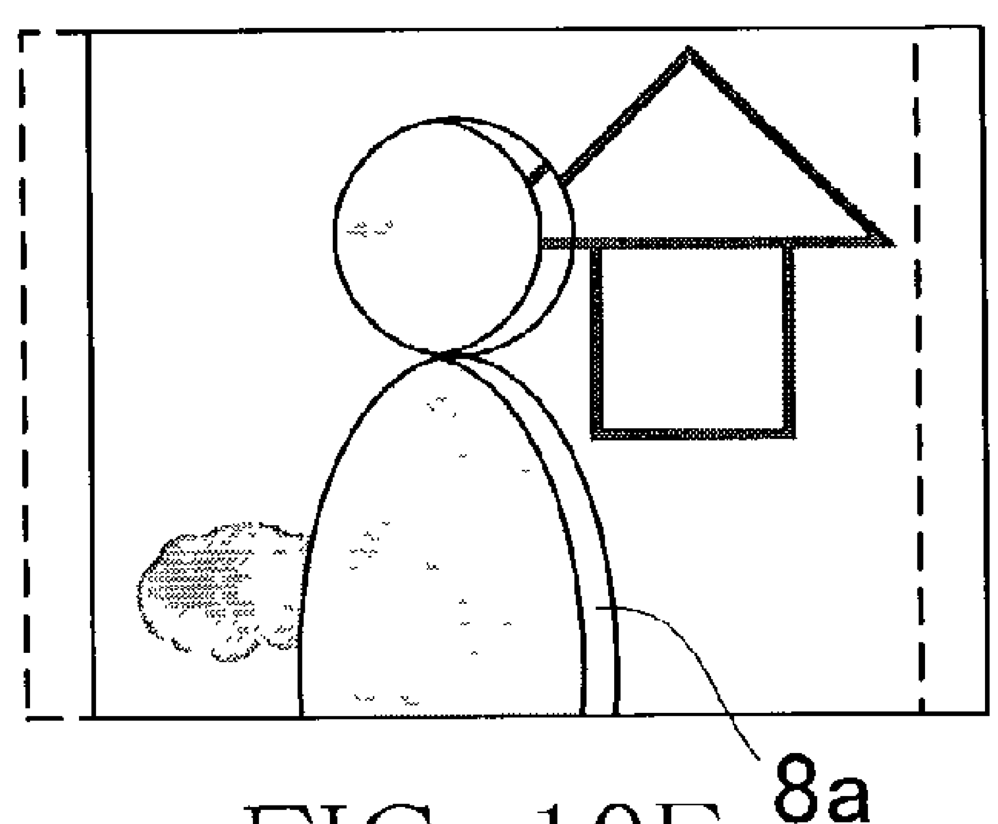


FIG. 10E

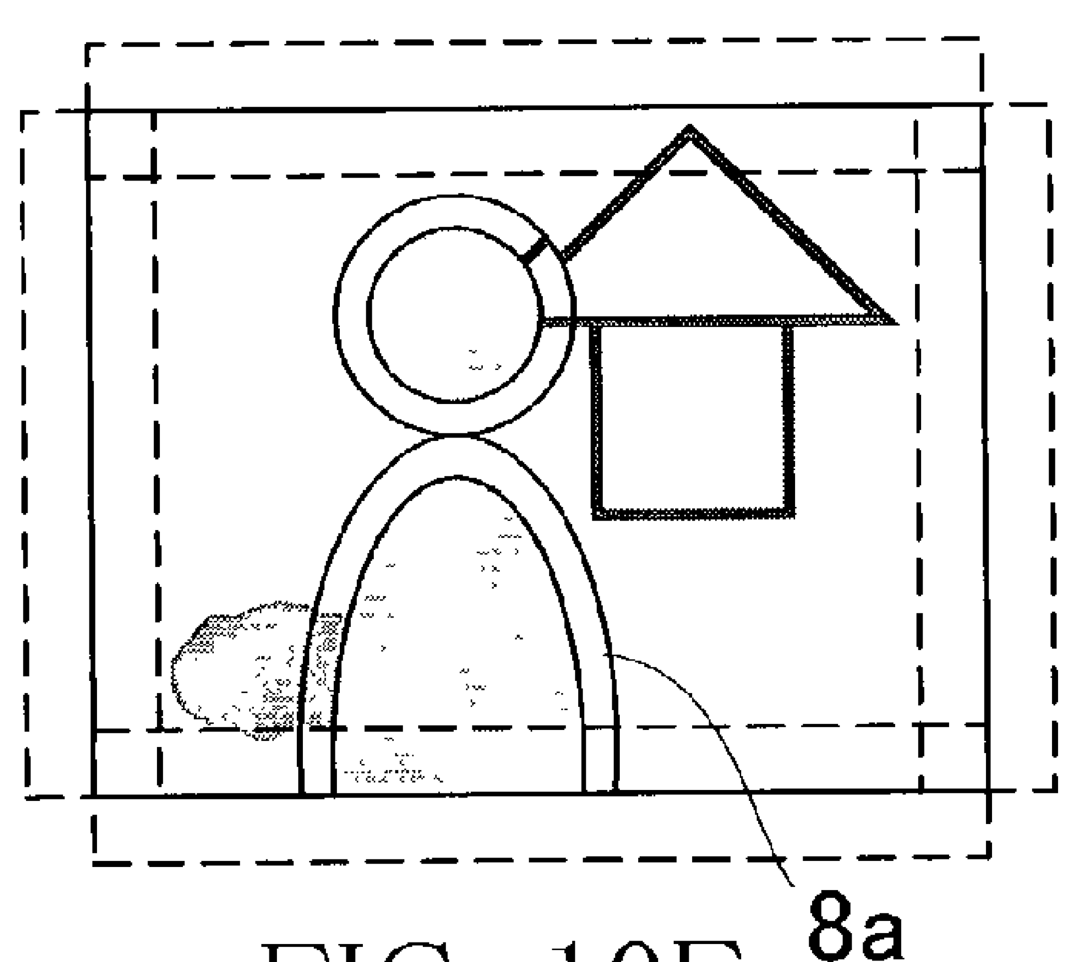


FIG. 10F

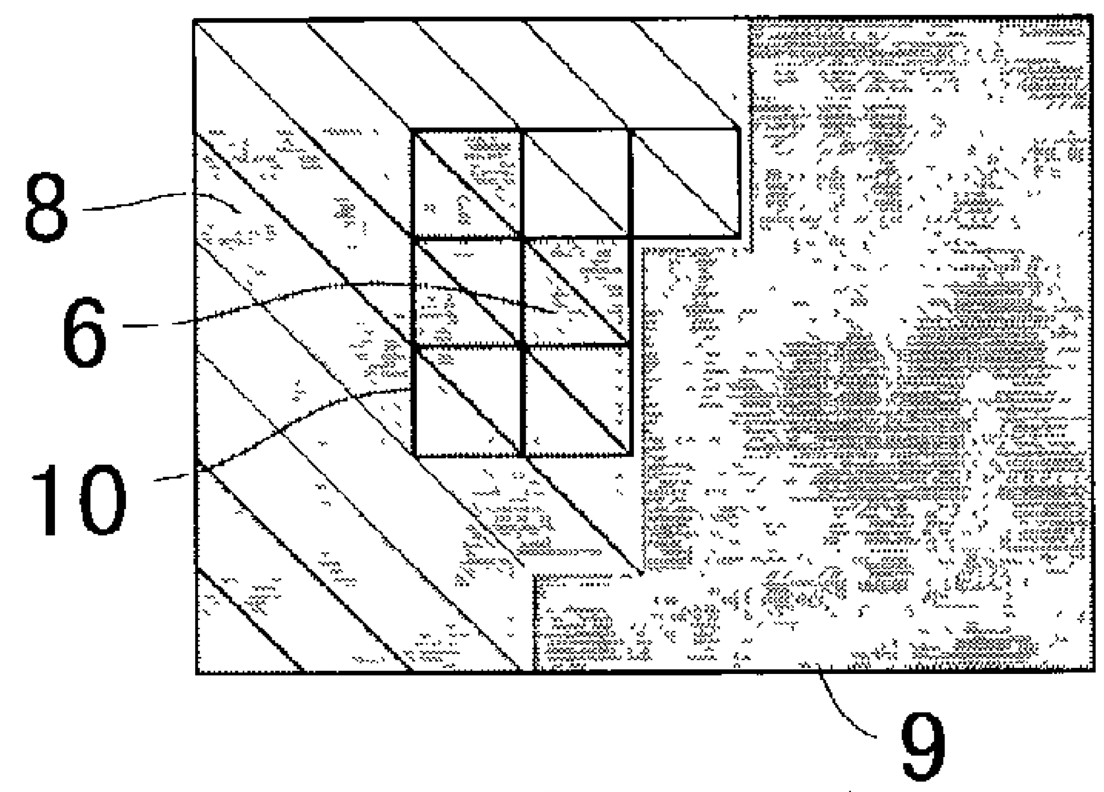
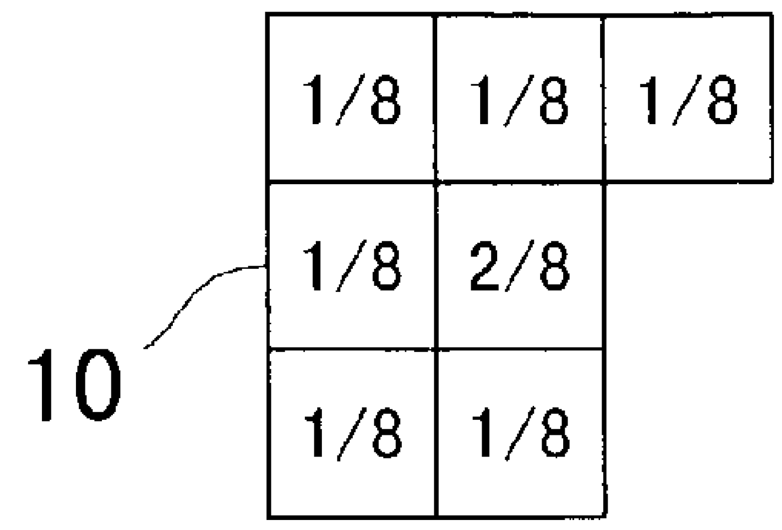


FIG. 11A



1/8	1/8	1/8
1/8	2/8	
1/8	1/8	

FIG. 11B

FIG. 11C

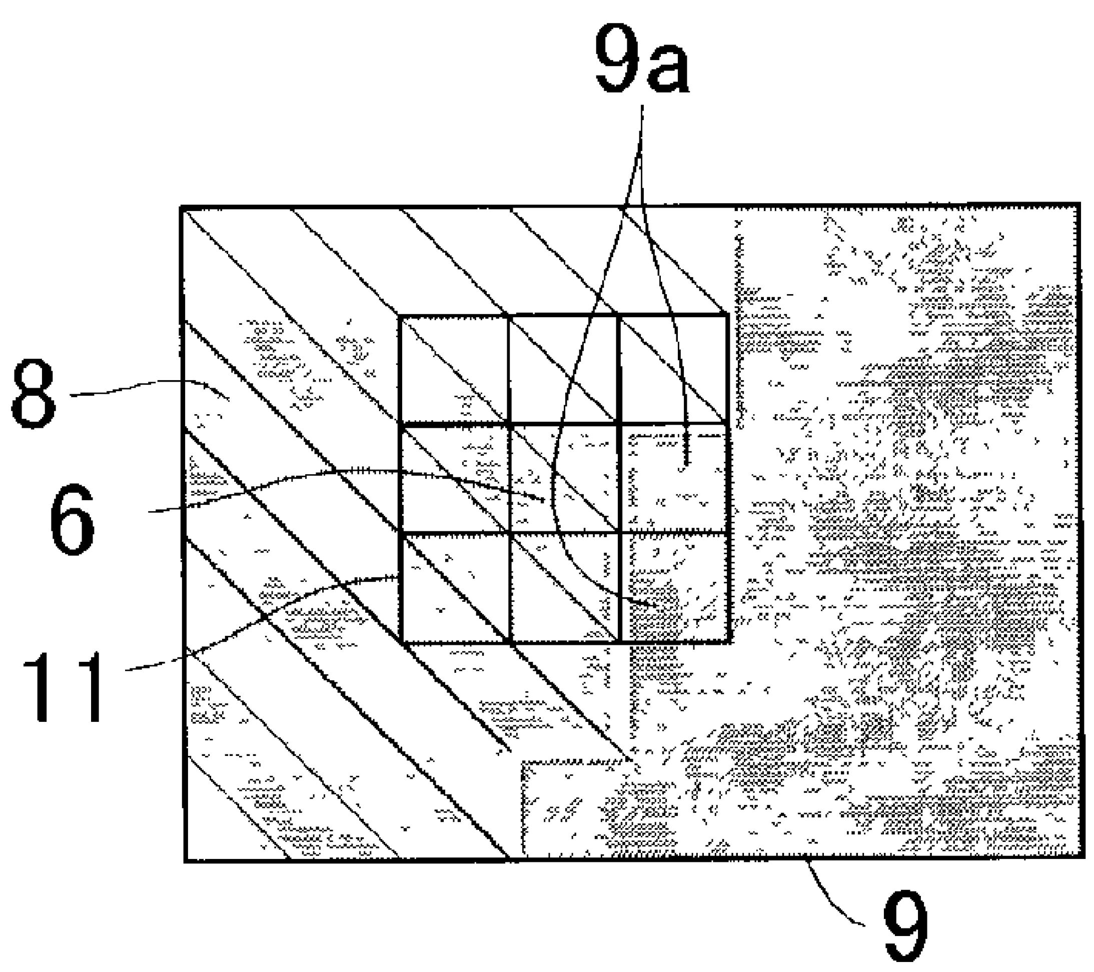


FIG. 12A

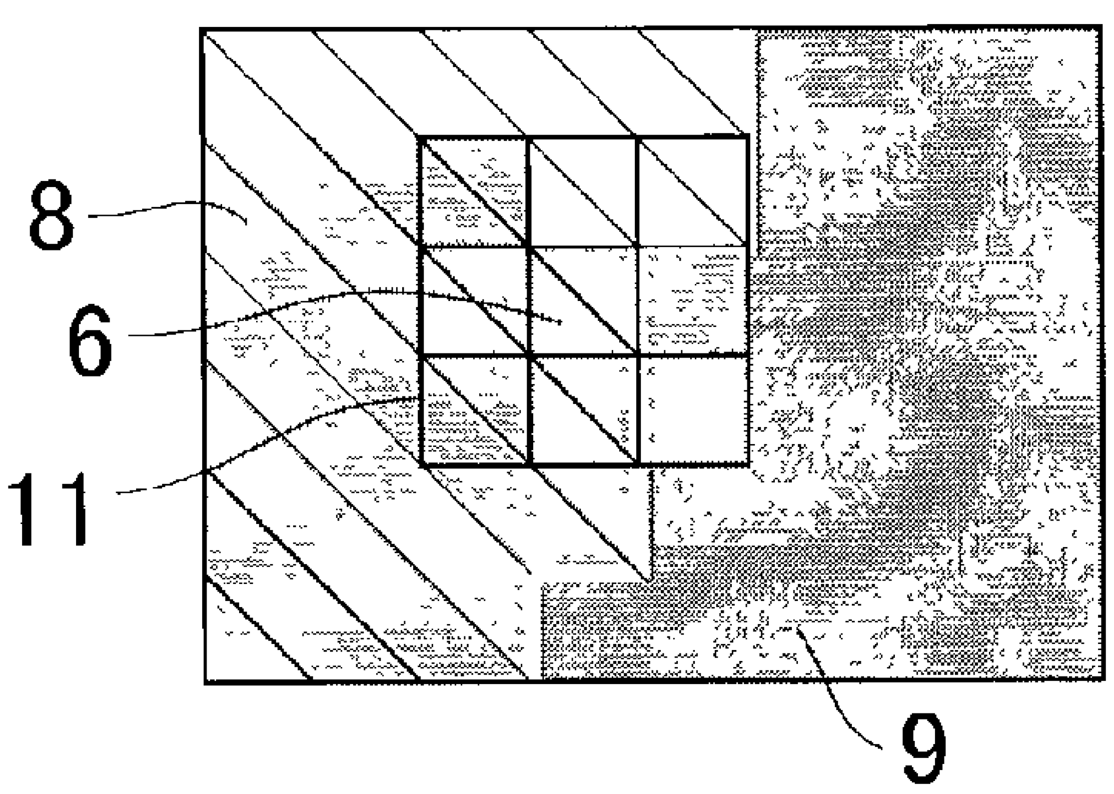
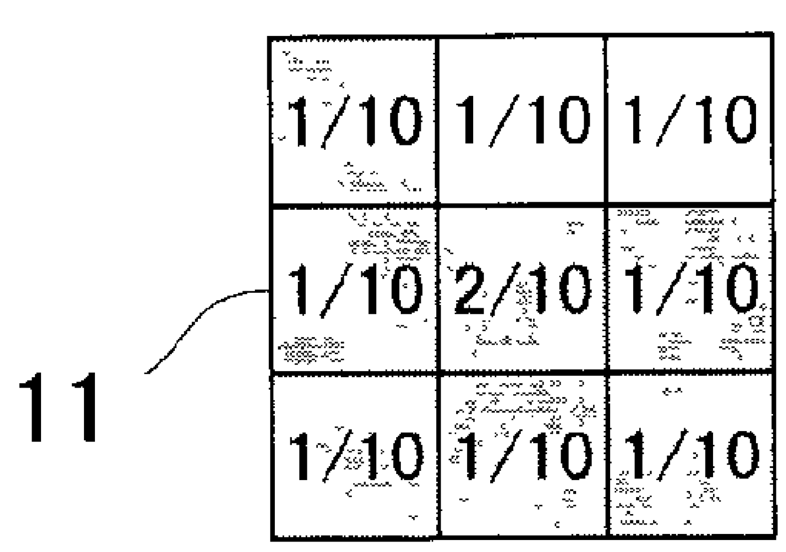


FIG. 12B



1/10	1/10	1/10
1/10	2/10	1/10
1/10	1/10	1/10

FIG. 12C

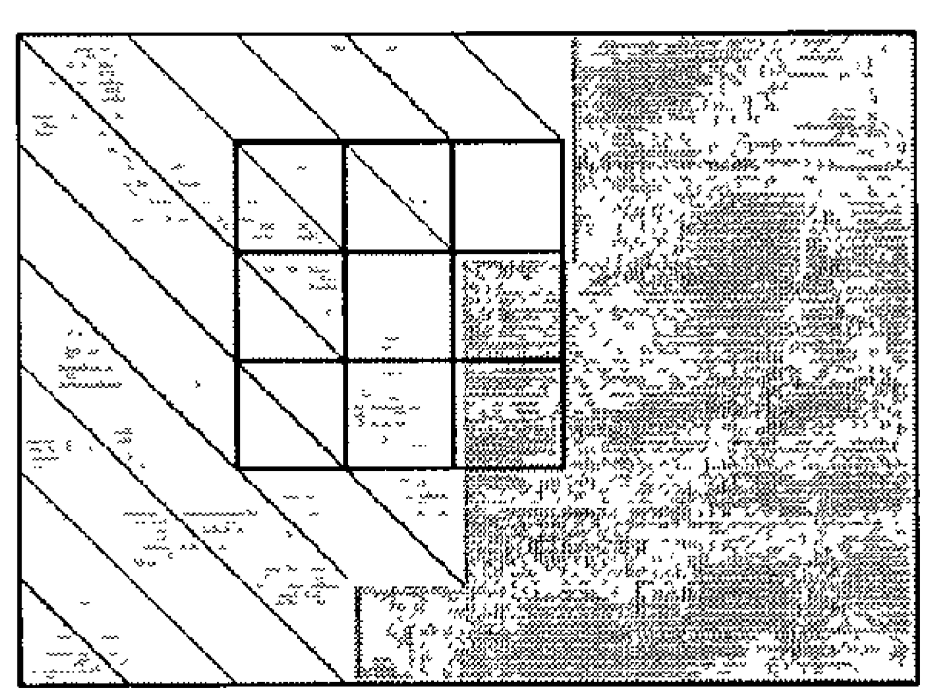


FIG. 12D

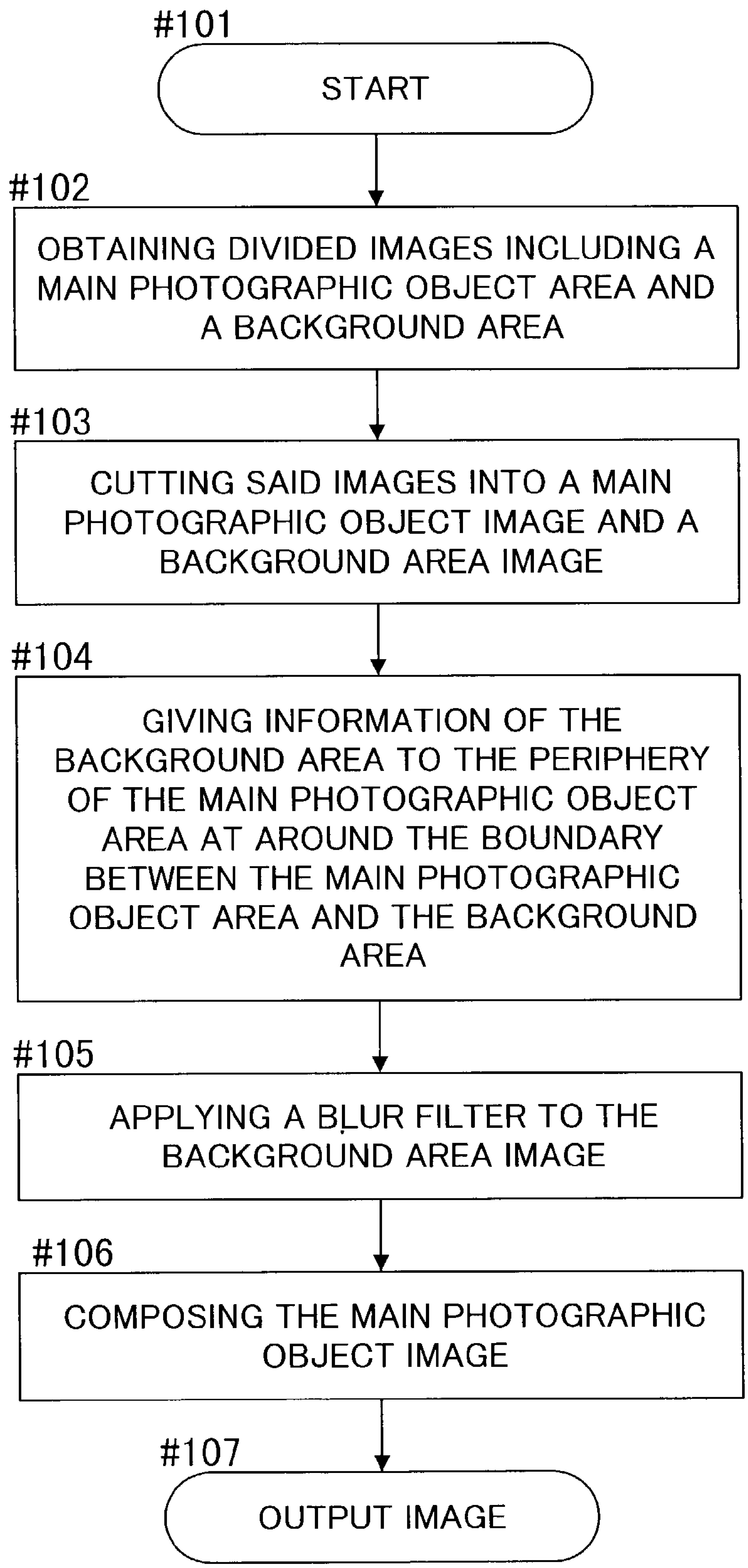

#101
START
#102
OBTAINING DIVIDED IMAGES INCLUDING A MAIN PHOTOGRAPHIC OBJECT AREA AND A BACKGROUND AREA
#103
CUTTING SAID IMAGES INTO A MAIN PHOTOGRAPHIC OBJECT IMAGE AND A BACKGROUND AREA IMAGE
#104
GIVING INFORMATION OF THE BACKGROUND AREA TO THE PERIPHERY OF THE MAIN PHOTOGRAPHIC OBJECT AREA AT AROUND THE BOUNDARY BETWEEN THE MAIN PHOTOGRAPHIC OBJECT AREA AND THE BACKGROUND AREA
#105
APPLYING A BLUR FILTER TO THE BACKGROUND AREA IMAGE
#106
COMPOSING THE MAIN PHOTOGRAPHIC OBJECT IMAGE
#107
OUTPUT IMAGE

FIG. 13

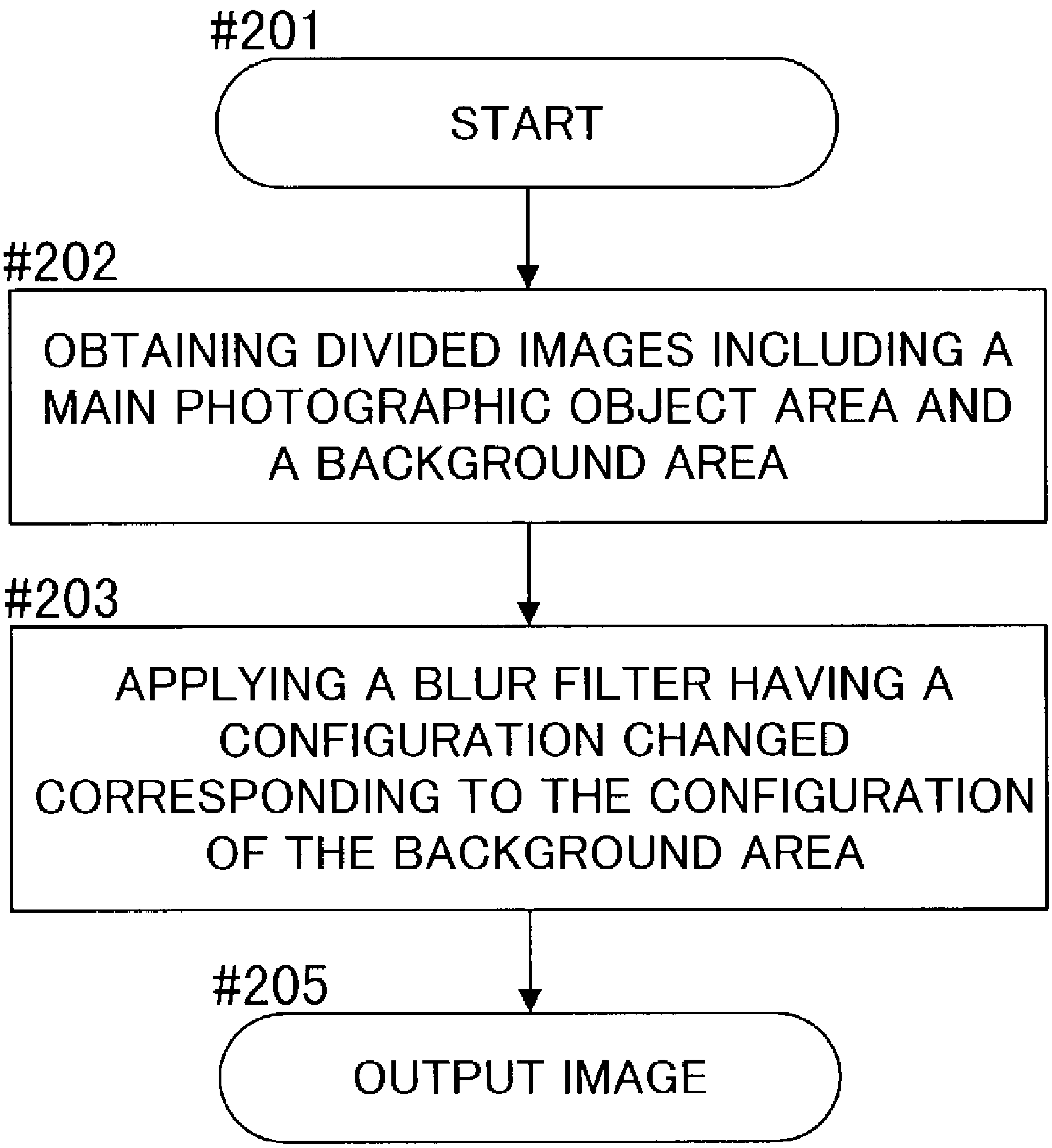

#201
START
#202
OBTAINING DIVIDED IMAGES INCLUDING A MAIN PHOTOGRAPHIC OBJECT AREA AND A BACKGROUND AREA
#203
APPLYING A BLUR FILTER HAVING A CONFIGURATION CHANGED CORRESPONDING TO THE CONFIGURATION OF THE BACKGROUND AREA
#205
OUTPUT IMAGE

FIG. 14

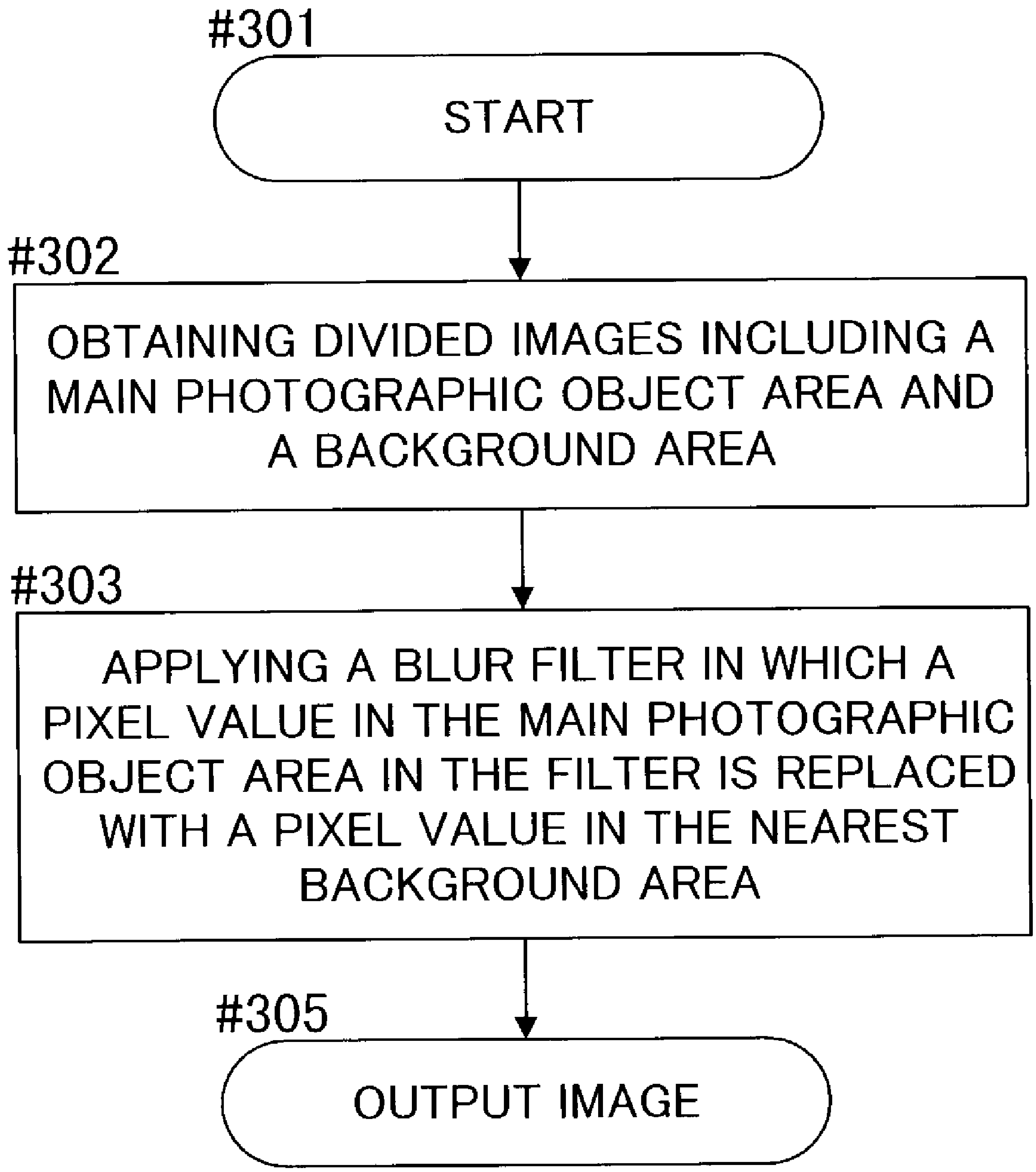

#301
START
#302
OBTAINING DIVIDED IMAGES INCLUDING A MAIN PHOTOGRAPHIC OBJECT AREA AND A BACKGROUND AREA
#303
APPLYING A BLUR FILTER IN WHICH A PIXEL VALUE IN THE MAIN PHOTOGRAPHIC OBJECT AREA IN THE FILTER IS REPLACED WITH A PIXEL VALUE IN THE NEAREST BACKGROUND AREA
#305
OUTPUT IMAGE

FIG. 15

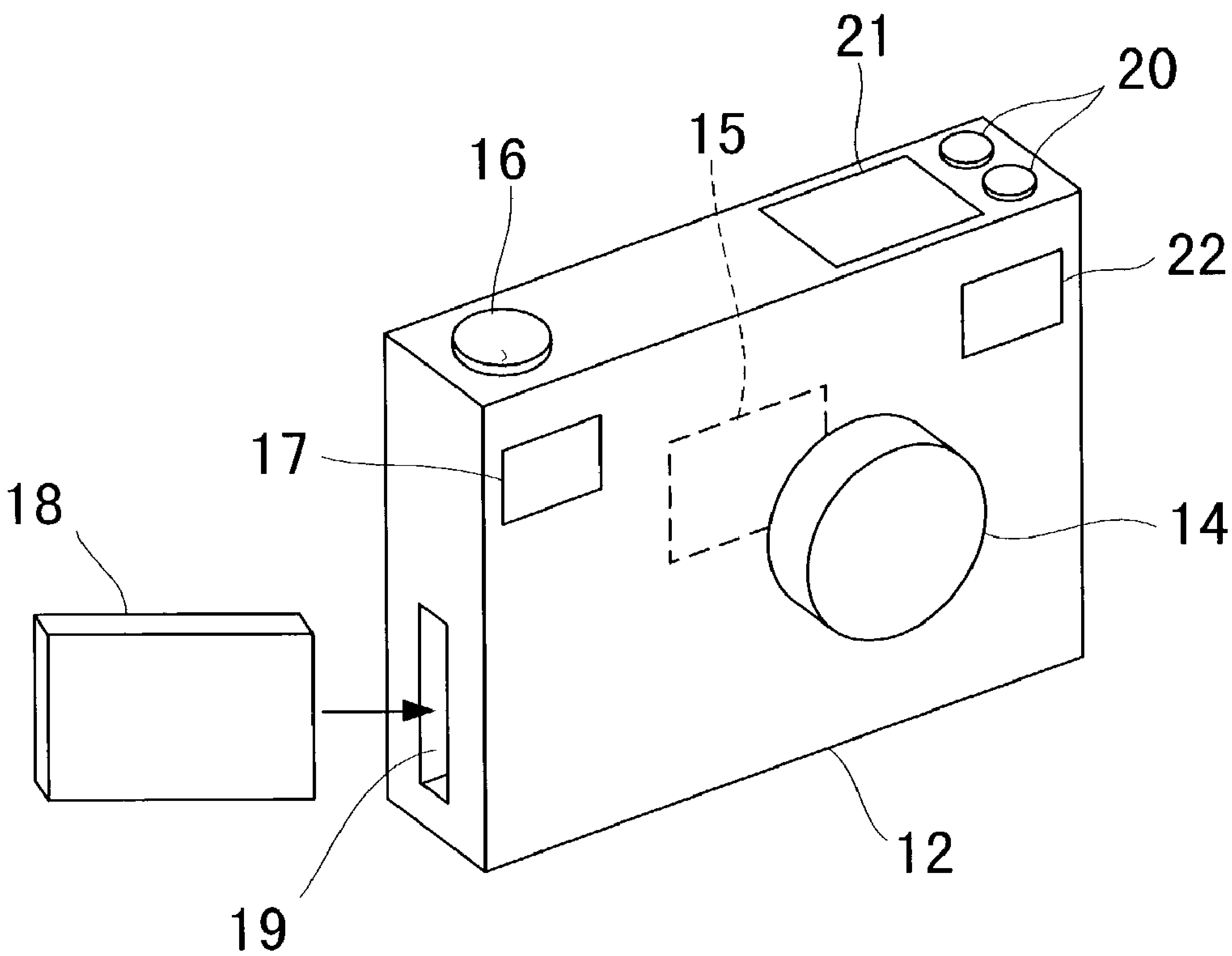


FIG. 16

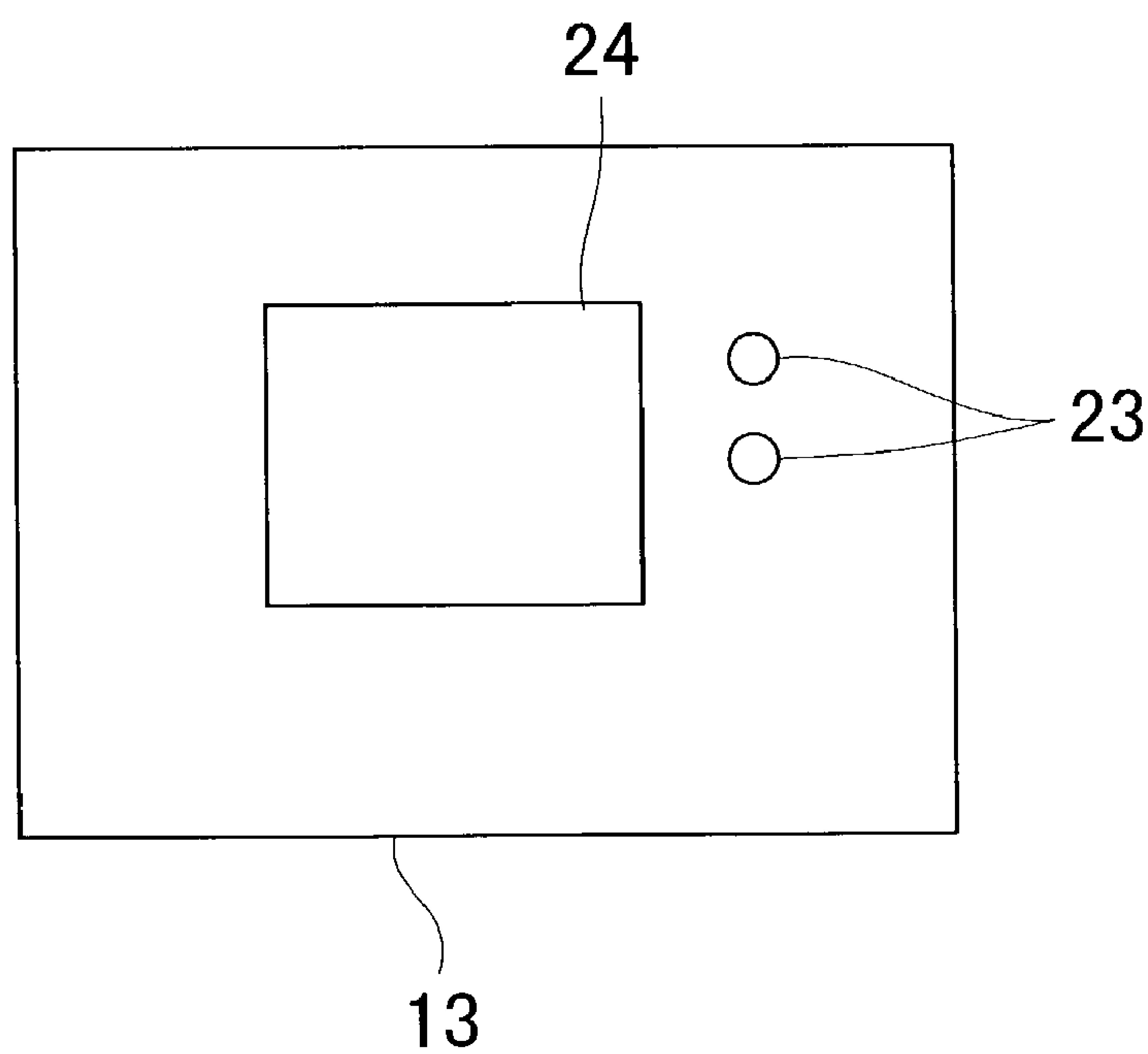


FIG. 17

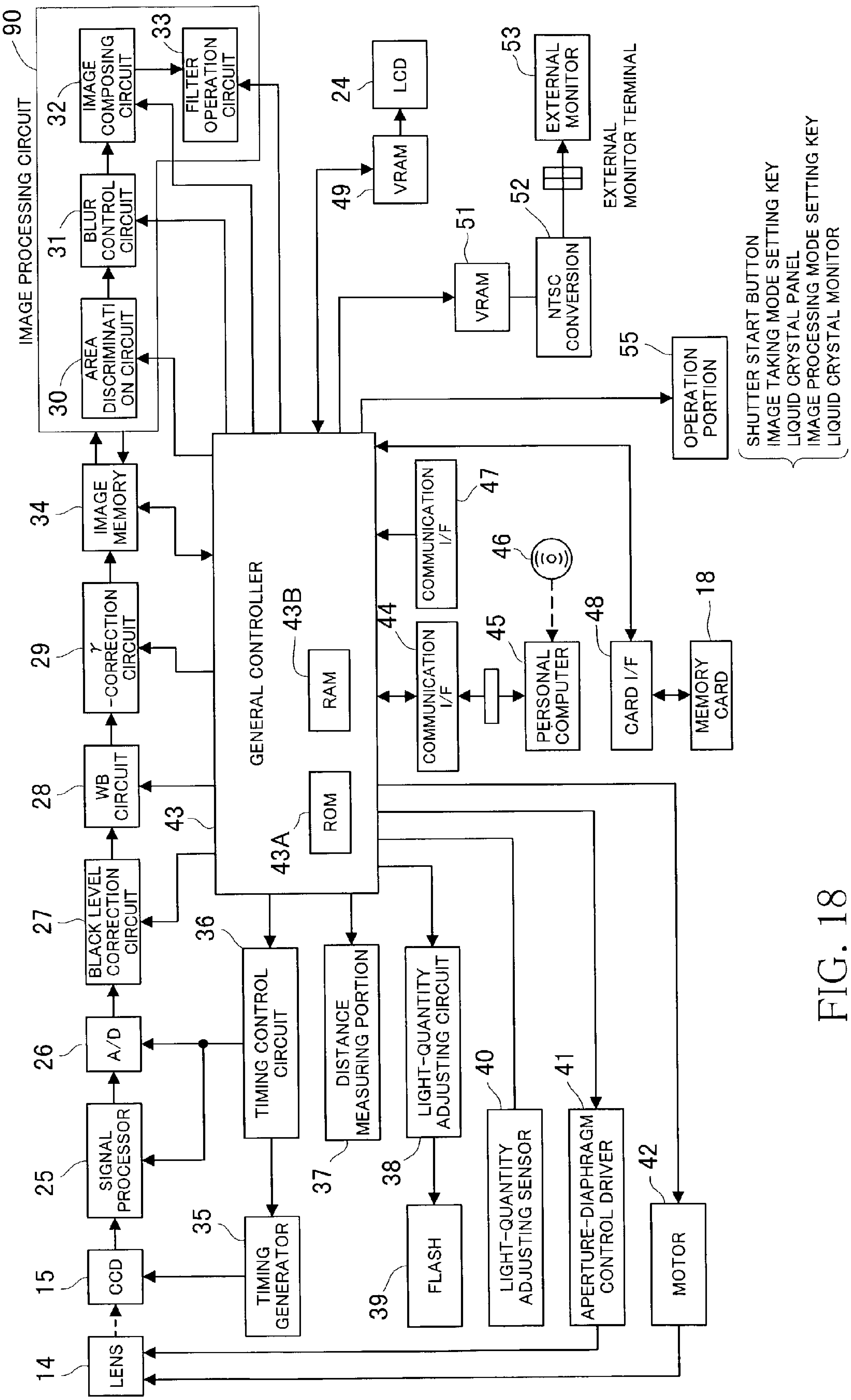


IMAGE PROCESSING CIRCUIT
90
AREA DISCRIMINATION CIRCUIT
BLUR CONTROL CIRCUIT
IMAGE COMPOSING CIRCUIT
FILTER OPERATION CIRCUIT
LCD
VRAM
EXTERNAL MONITOR
EXTERNAL MONITOR TERMINAL
VRAM
NTSC CONVERSION
OPERATION PORTION
SHUTTER START BUTTON
IMAGE TAKING MODE SETTING KEY
LIQUID CRYSTAL PANEL
IMAGE PROCESSING MODE SETTING KEY
LIQUID CRYSTAL MONITOR
LENS
CCD
SIGNAL PROCESSOR
A/D
BLACK LEVEL CORRECTION CIRCUIT
WB CIRCUIT
γ-CORRECTION CIRCUIT
IMAGE MEMORY
GENERAL CONTROLLER
ROM
RAM
COMMUNICATION I/F
COMMUNICATION I/F
PERSONAL COMPUTER
CARD I/F
MEMORY CARD
TIMING GENERATOR
TIMING CONTROL CIRCUIT
DISTANCE MEASURING PORTION
LIGHT-QUANTITY ADJUSTING CIRCUIT
FLASH
LIGHT-QUANTITY ADJUSTING SENSOR
APERTURE-DIAPHRAGM CONTROL DRIVER
MOTOR
14 15 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 43A 43B 44 45 46 47 48 49 51 52 53 55 18 24

FIG. 18

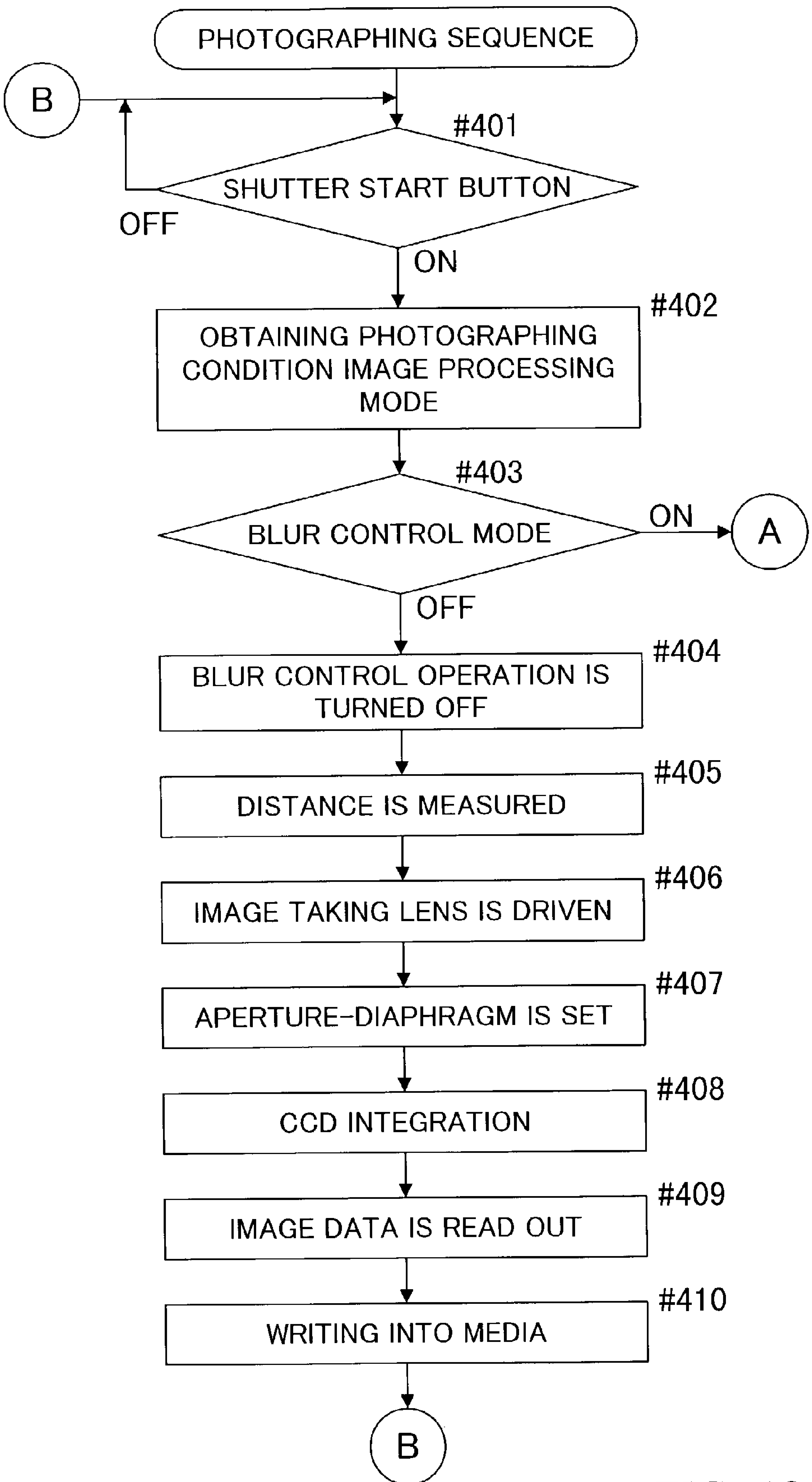

PHOTOGRAPHING SEQUENCE
B
#401
SHUTTER START BUTTON
OFF
ON
#402
OBTAINING PHOTOGRAPHING CONDITION IMAGE PROCESSING MODE
#403
BLUR CONTROL MODE
ON
A
OFF
#404
BLUR CONTROL OPERATION IS TURNED OFF
#405
DISTANCE IS MEASURED
#406
IMAGE TAKING LENS IS DRIVEN
#407
APERTURE-DIAPHRAGM IS SET
#408
CCD INTEGRATION
#409
IMAGE DATA IS READ OUT
#410
WRITING INTO MEDIA
B

FIG. 19

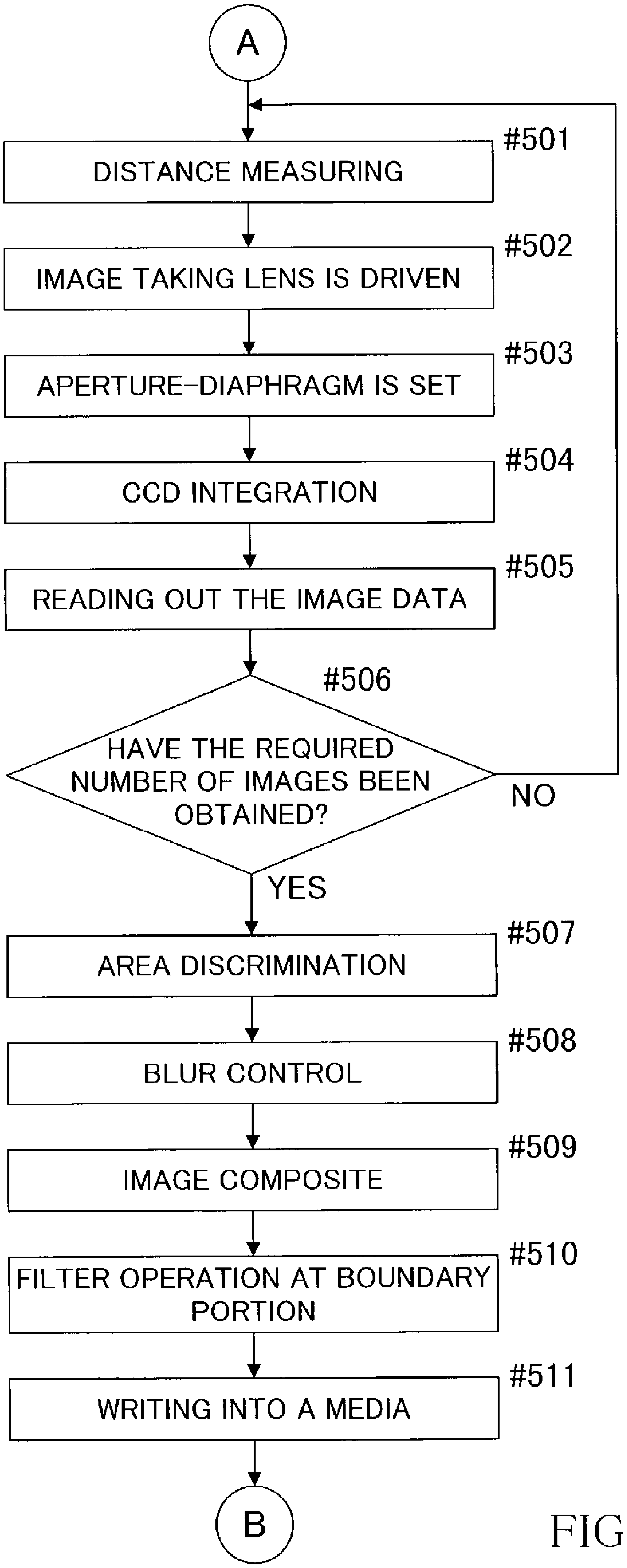

A
#501
DISTANCE MEASURING
#502
IMAGE TAKING LENS IS DRIVEN
#503
APERTURE-DIAPHRAGM IS SET
#504
CCD INTEGRATION
#505
READING OUT THE IMAGE DATA
#506
HAVE THE REQUIRED NUMBER OF IMAGES BEEN OBTAINED?
NO
YES
#507
AREA DISCRIMINATION
#508
BLUR CONTROL
#509
IMAGE COMPOSITE
#510
FILTER OPERATION AT BOUNDARY PORTION
#511
WRITING INTO A MEDIA
B

FIG. 20

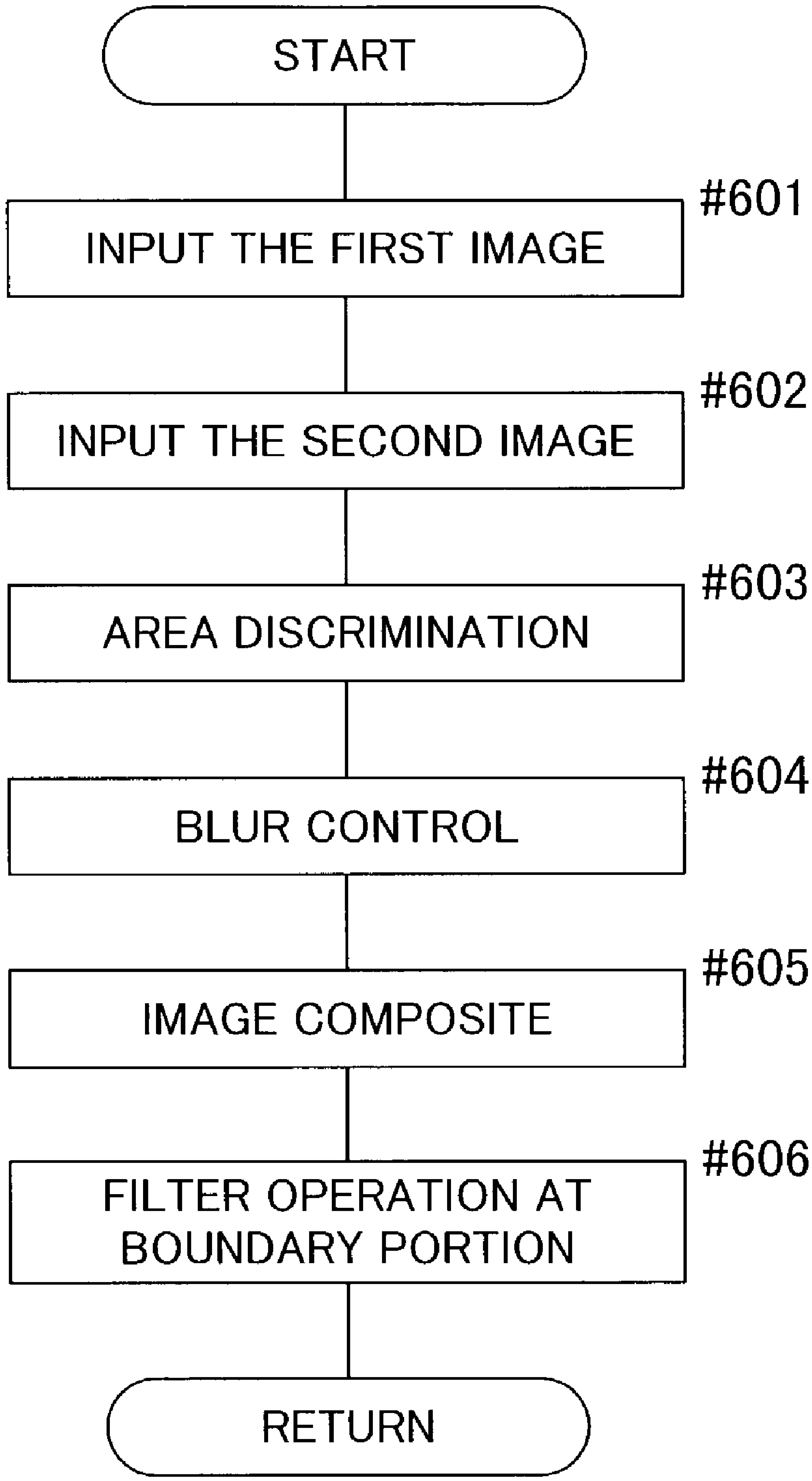

START
#601
INPUT THE FIRST IMAGE
#602
INPUT THE SECOND IMAGE
#603
AREA DISCRIMINATION
#604
BLUR CONTROL
#605
IMAGE COMPOSITE
#606
FILTER OPERATION AT BOUNDARY PORTION
RETURN

FIG. 21

IMAGE PROCESSING METHOD, IMAGE PROCESSING APPARATUS AND IMAGE PROCESSING PROGRAM

This application claims priority to Japanese Patent Application No. 2001-100655 filed on Mar. 30, 2001, the disclosure of which is incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image processing method for creating a blur-controlled image by performing a blur-control processing to an image obtained by a digital camera or the like. It also relates to an image processing apparatus and an image processing program.

2. Description of Related Art

In photographing, it is possible to emphasize the main photographic object by unsharpening or dimming (hereinafter referred to as "blur") the background and also possible to arbitrarily alter the emphasis degree of the main photographic object by changing the blur degree of the background. Although it is possible to change the blur degree in a camera capable of arbitrarily changing the aperture value so as to alter a depth of field, it is difficult to do so in a camera in which the aperture value is determined automatically.

In recent years, digital cameras have become popular. In digital cameras, it became possible to add various effects to an image by processing the image data. Furthermore, it also became possible to add various effects to a specific area in an image by an area dividing method by clustering or an area discrimination method in which a photographic object image is taken out from two images different in focal length based on the blur difference thereof.

For example, a blur-controlled image in which the main photographic object is emphasized can be created by applying a filter to the background. To the contrary, a blur-controlled image in which the background is emphasized can be created by applying a filter to the main photographic object. Furthermore, a pan-focus image can be also created by combining focused portions in two images.

In a conventional method, however, even if a desired area is taken out perfectly at the time of applying a blur-filter thereto, a pixel value of a pixel outside the desired area near a boundary is also taken in. As a result, a desired blurred image could not be obtained. This will be explained with reference to FIGS. **1** to **4**.

FIGS. **1** to **4** explain the situation at the time of carrying out a background blur emphasizing processing to an image.

FIG. **1** shows a landscape image including a person **1**, a house **2** and a pond **3**. This image shown in FIG. **1** is focused on a person **1**, and includes a clear person image **1** as a main photographic object in the foreground and slightly blurred images of a house **2** and a pond **3** in the background. This image is a far-and-near conflict image including unfocused images in the background area and a focused image in the main photographic object area in the same image frame.

In this image, it is discriminated such that the focused person image is an image in the main photographic object area **4** and that the unfocused landscape image including the house **2**, the pond **8** and therearound is an image in the background area **5**. The target area to which a blur-filter is to be applied is cut out by an area discrimination method. As shown in FIG. **2**, it is assumed that the image in the main photographic object area **4** has been cut out from the image shown in FIG. **1** by the area discrimination method.

By subjecting the image shown in FIG. **1** to predetermined filtering processing, a blur emphasized image is created. In this specification, a method for creating a background blur emphasized image in which the blur degree in the background area is emphasized will be explained.

FIG. **3** is an enlarged view showing the boundary portion between the image in the main photographic object area and the image in the background area shown in FIG. **1** for an explanation of the blur emphasizing processing in the boundary portion. The area with oblique lines denotes the background area **8**, and the remaining area denotes the main photographic object area **9**. A blur-filter **7** is applied to the aimed pixel **6** of the image in the background region **8**. This blur-filter **7** is shown in FIG. **3**B.

In the event that the blur-filter **7** shown in FIG. **3**B is applied to the pixel **6** near the boundary, this filter **7** covers not only the image in the background area **8** but also a part of the image in the main photographic object area **9**. Therefore, the aimed pixel **6** after the filtering processing includes the pixel value of the pixel in the part of the main photographic object area **9**, which creates a blur fault portion **8**' (see FIG. **3**C). FIG. **4**A shows a filtered image obtained by subjecting the entire area of the image shown in FIG. **1** to blur-filtering processing. At near the boundary of the background area **5** to which the blur-filtering processing was performed, the pixel value is a mixed value of the pixel value of the skin color of the person image and that of the dress color. This portion including the mixed value remains as a fault portion **8**' at the periphery of the main photographic object area **4** as shown in FIG. **4**B when the previously cut-out image (FIG. **2**) in the main photographic object area **4** is pasted on the aforementioned filtered image.

As mentioned above, in a conventional method, a good blur cannot be given to the boundary when applying a blur-filter to the image in the aimed area.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an image processing method capable of creating a good blur by blur-control processing.

It is another object of the present invention to provide an image processing apparatus for performing blur-control processing capable of creating a good blur.

It is still another object of the present invention to provide a program for making a computer execute blur-control processing capable of creating a good blur.

According to the first aspect of the present invention, an image processing method comprises the steps of:

obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other; and

a control step for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound when the blur control is performed to the second image.

According to this image processing method, when a blur control is performed to the second image by the filter, a blur control is performed to the second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound. Accordingly, it is possible to avoid performing the blur control in a state that the influence of the first area appears as it is in the second area near the boundary, and therefore a good blur-controlled image can be obtained.

According to the second aspect of the present invention, an image processing apparatus, comprises;

a processor for obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other; and

a blur controller for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound when the blur control is performed to the second image.

According to this image processing apparatus, when a blur control is performed to the second image by the filter, a blur control is performed to the second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound. Accordingly, the influence of the first area would not appear in the second area near the boundary.

According to the third aspect of the present invention, a computer readable program for attaining the following functions:

obtaining an image in which a first area having a first image and a second area having a second image are discriminated with each other; and

performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound when the blur control is performed to the second image.

According to this program, when a blur control is performed to the second image by the filter, a computer performs a blur control to the second image while accompanying processing for reducing an influence of the first area at a boundary between the first area and the second area and therearound. Accordingly, an image in which the influence of the first area is reduced in the second area near the boundary can be obtained.

Other objects and the features will be apparent from the following detailed description of the present invention with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully described and better understood from the following description, taken with the appended drawings, in which:

FIG. **1** shows a far-and-near conflict image including a main photographic object image and a background image;

FIG. **2** shows a state in which an image in the main photographic object area and an image in the background area are discriminated;

FIGS. **3**A to **3**C are explanatory views showing a conventional blur emphasizing processing at the boundary between the image in the main photographic object area and the image in the background area;

FIGS. **4**A and **4**B show images obtained by performing blur-filter processing to the entire image shown in FIG. **1**;

FIG. **5**A shows a far-and-near conflict image including a main photographic object image and a background image, FIG. **5**B shows the background image obtained by cutting out the main photographic object from the entire image and FIG. **5**C shows the main photographic object image cut out from the entire image;

FIG. **6** shows an image in which a pixel value of a pixel in the background area is given to the area near the boundary in the main photographic object area;

FIGS. **7**A to **7**D are explanatory views showing an image processing method according to the first embodiment of the present invention;

FIG. **8** shows an image obtained by applying the image processing method shown in FIGS. **7**A to **7**D to the entire image shown in FIG. **6**;

FIG. **9** shows a composite image obtained by pasting the original image in the main photographic object area on the image shown in FIG. **8**;

FIGS. **10**A to **10**F are explanatory views of a method for giving a pixel value of a pixel in a background area to the boundary and therearound in the cut-out main photographic object area;

FIGS. **11**A to **11**C are explanatory views of an image processing method according to the second embodiment of the present invention;

FIGS. **12**A to **12**D are explanatory views of an image processing method according to the third embodiment of the present invention;

FIG. **13** is a flowchart showing the image processing method according to the first embodiment of the present invention;

FIG. **14** is a flowchart showing the image processing method according to the second embodiment of the present invention;

FIG. **15** is a flowchart showing the image processing method according to the third embodiment of the present invention;

FIG. **16** is a perspective view showing a digital camera i.e., an image processing apparatus which carries out the image processing method according to the first embodiment;

FIG. **17** is a rear view showing the digital camera;

FIG. **18** is a block diagram showing the electric structure of the digital camera;

FIG. **19** is a flowchart showing the photographing sequence by the digital camera;

FIG. **20** is a continuation of the flowchart of FIG. **19**; and

FIG. **21** is a flowchart in cases where a computer performs the image processing.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First, the image processing method according to the first embodiment will be explained with reference to a landscape image including an image of a person **1** as the main photographic object and images of a house **2** and a pond **3** as the background as shown in FIG. **5**A. FIG. **5**A shows an image focused on the person **1**. In this image, the person **1** as the main photographic object in the foreground is taken clearly, while the house **2** and the pond **3** in the background are slightly blurred. This image is a far-and-near conflict image including an unfocused image in the background area and a focused image in the main photographic object area. In this embodiment, although an image in the main photographic object area is explained as a "person image" at the time of a blur control operation, it is not necessary to limit the image in the main photographic object area to a "person image." Furthermore, although a "house" and a "pond" are exemplified as the images in the background area, it is not necessary to limit the images in the background area to the images of a "house" and a "pond."

First, from the image shown in FIG. **5**A, the image in the first area and that in the second area are cut out. For example, the image in the main photographic object area **4** and the image in the background area **5** are cut out. In FIG. **5**B, only the image in the background area **5** is cut out. On the other hand, in FIG. **5**C, only the image in the main photographic object area **4** is cut out. The cutout is performed by an area discrimination method. Although this area discrimination method uses blur difference, edge intensity or the like, the cutting out may be performed by any other known technique and/or methods. The image shown in FIG. **6** is created from the image shown in FIG. **5**B, and is processed by a blur-filter **7**.

FIG. **6** shows an image obtained by giving the pixel value **8***a* of the pixel in the background area near the boundary between the main photographic object area and the background area to the periphery of the background area in the main photographic object area shown in FIG. **5**B after cutting out the image in the main photographic object area. The method for giving the pixel value in this background area will be mentioned later.

FIG. **7**A is an enlarged view showing the image of the boundary portion between the main photographic object area and the background area before giving the pixel value **8***a* (FIG. **5**B). FIG. **7**B is an enlarged view showing the boundary portion after giving the pixel value **8***a* (FIG. **6**). By applying a blur-filter **7** to the image shown in FIG. **7**B, an image shown in FIG. **7**C is obtained. In this embodiment, although a 3×3 weighted average filter **7** is used as the blur-filter **7**, it is not necessary to limit the size, type of the filter to the 3×3 weighted average filter **7**. For example, any filter may be used as long as the filter has a blur making effect such as a Gaussian filter. In a conventional method, as shown in FIG. **3**A, the blur-filter **7** located at the aimed pixel **6** covers the image in the main photographic object area **9**. To the contrary, in this embodiment, since the pixel value of the pixel near the boundary in the main photographic object area **9** is replaced by the pixel value **8***a* of the pixel in the background area **8**, the pixel value in the main photographic object area **9** would not invade. Accordingly, even at the boundary and therearoud, a blur-filter processing can be performed without causing invasion of the pixel value in the other areas. Then, the original image in the main photographic object area **9** is pasted on the image shown in FIG. **7**C to create the image shown,in FIG. **7**D. FIG. **8** is an entire view corresponding to FIG. **7**C showing an image created by applying the aforementioned image processing method to the entire image near the boundary shown in FIG. **6**. Thus, the entire image in the background area can be blurred without incorporating the pixel value of the image in the main photographic object area even at the boundary near the main photographic object area.

FIG. **9** is a final result obtained by pasting the original image in the main photographic object area **4** on the image shown in FIG. **8**, and shows an entire drawing corresponding to FIG. **7**D. By pasting the image in the main photographic object area **4**, the background area information previously given to the area near the boundary in the main photographic object area can be removed.

FIGS. **10**A to **10**F are drawings for explaining the method for giving the pixel value of the pixel in the background area to the periphery of the image of the background area (i.e., the boundary portion between the main photographic object area and the background area in the main photographic object area) obtained by cutting out the image in the main photographic object area from the entire image.

FIG. **10**A shows an image obtained by cutting out the image in the main photographic object area **4** from the entire image shown in FIG. **5**A showing a far-and-near conflict scene, and FIG. **10**B shows an image obtained by reducing the size of the image shown in FIG. **10**A at a certain reduction rate. The image shown in FIG. **10**A is pasted on this reduced image shown in FIG. **10**B to obtain the image shown in FIG. **10**C. By this operation, the pixel value **8***a* in the background area of the reduced image shown in FIG. **10**B can be given to the boundary portion in the main photographic object area shown in FIG. **10**A.

On the other hand, FIG. **10**D shows an image obtained by moving the image shown in FIG. **10**A from the original position to the left side by a certain number of pixels.

By pasting the image shown in FIG. **10**A on the moved image shown in FIG. **10**D, the pixel value **8***a* in the background area of the image shown in FIG. **10**D can be given to a part of the boundary portion in the previously cut main photographic object area shown in FIG. **10**A (see FIG. **10**E).

This processing is performed leftward, rightward, upward and downward, to thereby give the pixel value **8***a* in the background area to the remaining boundary portion in the main photographic object area. As a result, an image in which the information on the background area is given to the entire periphery of the image of the background area (the periphery is in the main photographic object area) can be obtained (see FIG. **10**F).

The size of the background area to be given to the main photographic object area is set such that the size is changed according to the size and the type of the blur-filter to be used and that the pixel value in the main photographic object area does not enter the filter even if the filter is applied to any pixel in the background area.

Although the above explanations are directed to two methods, a method in which an image size is reduced and a method in which an image position is moved, a pixel value in the background area may be given to the periphery of the image of the background area by another method.

FIGS. **11**A to **11**C are explanatory views showing the second embodiment of the present invention. FIG. **11**A is an enlarged image near the boundary between the background area **8** and the main photographic object area **9**. In this embodiment, the configuration of the blur-filter is changed according to the configuration of the background area **8**. In this embodiment, the configuration of the blur-filter to the aimed pixel **6** is changed into the configuration corresponding to the boundary of the background area. At this time, the value of the denominator of the weighted average filter also changes along with the size of the filter, and the value becomes the sum of the entire numerator in the filter. This enables to perform the blur processing without invasion of the image information in the other area even at the boundary in the background area and therearound. FIG. **11**C is an enlarged view showing the state that the image in the main photographic object area is pasted after the blur processing. This processing also enables to obtain the final composite image as shown in FIG. **9**.

FIGS. **12**A to **12**D are explanatory views showing the third embodiment of the present invention.

FIG. **12**A is an enlarged image near the boundary between the background area **8** and the main photographic object area **9**. In this embodiment, in cases where the pixels **9***a* in the main photographic object area **9** are included in the pixels to be processed in the blur-filter processing as shown in FIG. **12**A, the nearest pixel value in the pixels in the background area **8** to be filter processed is used in place of the pixel value of the aforementioned pixel (see FIG. **12**B). Consequently, the pixel value in the blur-filter in the aimed pixel **6** becomes that of the filter **11** shown in FIG. **12**C. Since this is a filter in the aimed pixel **6**, the pixel value in the main photographic object area does not change. Therefore, it is possible to perform the blur processing without invasion of the information in the main photographic object even at the boundary in the background area and therearound. FIG. **12**D is an enlarged view showing the state that the image in the main photographic object area is pasted after the blur processing.

By this process shown in FIG. **12**, the final composite image as shown in FIG. **9** can be obtained. By the processing method according to the first to the third embodiments, a good blur-controlled image in which only the background is blurred can be obtained without invasion of the pixel value in another area at the time of performing the blur control.

FIG. **13** is a flowchart for explaining the flow of the processing of the first embodiment mentioned above. In the following explanation and the drawing, "#" denotes a step.

In FIG. **13**, the processing starts in **#101**. Next, in **#102**, an input image divided into the background area and the main photographic object area is obtained. In **#103**, each of the background area and the main photographic object area is cut out to obtain separate images. In **#104**, the background area pixel value near the boundary is given to the periphery of the background area image (boundary portion in the main photographic object area after cutting out the image in the main photographic object area). In **#105**, a blur-filter is applied to this image. In **#106**, the image in the main photographic object area is pasted on this image. In **#107**, the final image is outputted.

FIG. **14** is a flowchart for explaining the flow of the processing in the second embodiment mentioned above. In FIG. **14**, the processing starts in **#201**. Next, in **#202**, an input image which is divided into the background area and the main photographic object area is obtained. In **#203**, a blur-filter is applied to this image. At the time of the blur-filter processing at the boundary, the configuration of this blur filter is made to change depending on the configuration of the background area while preventing the invasion of the pixel value of the main photographic object area. In **#205**, the final image is outputted.

FIG. **15** is a flowchart for explaining the flow of the processing of the third embodiment mentioned above. In FIG. **15**, the processing starts in **#301**. Next, in **#302**, an input image divided into the background area and the main photographic object area is obtained. In **#303**, a blur-filter is applied to this image. At the time of the blur-filter processing of the boundary and therearoud, the pixel value in the main photographic object area in this blur-filter is replaced with the pixel value in the nearest background area. In **#305**, the final image is outputted.

FIGS. **16** and **17** show a digital camera which is an image processing apparatus according to one embodiment of the present invention. FIG. **16** is a perspective view showing the digital camera, and FIG. **17** is the rear view of the digital camera.

In FIGS. **16** and **17**, on the front face of the digital camera **12**, an image taking lens **14**, a finder window **17**, a distance measurement window **22**, etc. are provided. In the digital camera **12**, a CCD**15**, an example of the image taking element which receives an optical image formed by the aforementioned image taking lens **14** and performs a photoelectric conversion of the optical image, is disposed. An image taking unit including the image taking lens **14** and the CCD **15** is constituted.

Furthermore, on the upper surface of the digital camera **12**, a shutter start button **16**, photographing mode setting keys **20**, a liquid crystal panel **21**, etc. are provided. At the side surface of the digital camera **12**, the insertion slit **19** into which a recording media **18** such as a memory card is removably inserted is provided.

The photographing mode setting keys **20** are used for setting an exposure condition, such as an aperture priority exposure and a shutter speed priority exposure, changing macro image taking modes or setting a zoom condition while confirming the contents displayed on the liquid crystal display panel **21**.

Furthermore, as shown in FIG. **17**, an LCD monitor **24** for a live-view display, i.e., a real-time display of a photographic object image, image-processing mode setting keys **23**, etc. are provided on the rear face **13** of the digital camera **12**. These image-processing mode setting keys **23** are used for selecting a normal processing mode or a blur-control processing mode.

This digital camera **12** can record images picked-up by the CCD **15** into the recording media **18** in the same way as conventional digital cameras.

FIG. **18** is a block diagram of the digital camera **12**, and the arrows denote data flows.

The CCD **15** photoelectrically converts the optical image focused by the image taking lens **14** into image signals of color components R (red), G (green) and B (blue), and outputs them. The image signal consists of sequence of pixel signals received by the respective pixel. The timing generator **35** creates various kinds of timing pulses for controlling the drive of the CCD **15**.

In this digital camera **12**, the exposure control is performed by adjusting the aperture-diaphragm provided in the lens barrel of the image taking lens **14** and the quantity of light exposure of the CCD **15**, i.e., the electric charge accumulation time of the CCD **15** corresponding to the shutter speed. When the luminance of the photographic object is too low to appropriately adjust the quantity of light exposure by the shutter speed and the aperture value, the level of the image signal outputted from the CCD **15** is adjusted in order to compensate for the insufficient exposure. In other words, at a low luminance, the exposure is controlled by adjusting the gain. The level of the image signal is adjusted by controlling the gain of the AGC circuit in the signal processor **25**.

The timing generator **35** generates the drive control signal for the CCD **15** based on the reference clock transmitted from the timing-control circuit **36**. The timing generator **35** generates clock signals, such as a timing signal for starting and finishing integration (i.e., exposure), clock signals (horizontal synchronizing signals, vertical synchronizing signals, transferring signals, etc.) for controlling the reading timing of the light-receiving signals from the respective pixels. These timing signals are supplied to the CCD **15**.

The signal processing circuit **25** performs predetermined analog signal processing to the image signal (analog signal) outputted from the CCD **15**. The signal processing circuit **25** has a CDS (correlation double sampling) circuit for reducing the noise of the image signal and an AGC (automatic gain control) circuit for adjusting the level of the image signal by controlling the gain of this AGC circuit.

The light-quantity adjusting circuit **38** sets the light emission of the built-in flash **39** to a predetermined level determined by the general control portion **43** when the flash is used during the image taking. During the flash image taking, the flash light reflected from the photographic object is received by the sensor **40** upon starting exposure. When the quantity of light received by the sensor **40** reaches a predetermined level, the general control portion **43** supplies a flash stop signal to the light-quantity adjusting circuit **38**. In response to the flash stop signal, the light-quantity adjusting circuit **38** stops the light emission of the built-in flash **39** forcibly, whereby the light emission amount of the built-in flash **39** can be regulated to correct level.

The distance measurement portion **37** measures the distance to the photographic object.

The A/D converter **26** converts each pixel signal (analog signal) into a 10-bit digital signal based on the clock for A/D conversion.

The timing-control circuit **36** generates the reference clock and clocks to the timing generator **35** and the A/D converter **26**. The timing-control circuit **36** is controlled by the general control portion **43**.

The black level correction circuit **27** corrects the black level of the pixel signal (hereinafter referred to as pixel data) converted by the A/D converter **26** to the reference black level. A white balance circuit (hereinafter referred to as WB circuit) **28** converts the level of the pixel data of each color component of R, G or B so that the correct white balance can be obtained after γ (gamma) correction. The WB circuit **28** converts the level of the pixel data of each color component of R, G, B using a level conversion table inputted from the general control portion **43**. The conversion coefficient (or the inclination of the characteristic line) for each color component in the level conversion table is set by the general control portion **43** every picked-up image.

The γ (gamma) correction circuit **29** corrects the γ characteristic of the pixel data. The γ correction circuit **29** has, for example, six γ correction tables with different gamma characteristics, and performs a γ correction of the pixel data by the predetermined γ correction table according to the photographed scene or the photographed conditions.

The image memory **34** stores the pixel data outputted from the γ correction circuit **29**. The memory capacity of the image memory **34** corresponds to M frames. Accordingly, if the CCD **15** has an n×m pixel matrix, the image memory **34** has a memory capacity of M×n×m pixel data, and each pixel data is stored in the corresponding pixel position in the memory. Based on the stored pixel data corresponding to M frames, the blur-control processing is performed in the image processing circuit **90**. The processed pixel data is returned to the image memory **34** and stored therein.

The area discrimination circuit **30** discriminates an area using the blur difference, and divides the area. The blur-control circuit **31** performs the blur-control processing to the image whose area is divided by the method according to one of the aforementioned first to third embodiments. The image composing circuit **32** composes the blur-controlled images into one image.

If the image at the boundary between the area to which the blur-filtering operation was performed and the area where no blur-filtering operation was performed looks something wrong, a filter operation circuit **33** enlarges the boundary portion by several pixels in each direction toward the main photographic object area and the background area, and performs the blur-filtering operation to the enlarged area.

A VRAM **49** is a buffer memory for storing the image data to be reproduced and displayed on the LCD display portion **24**. The memory capacity of the VRAM **49** corresponds to the number of pixels of the LCD display portion **24**.

In the image taking preparation mode, each pixel data of the image taken by the CCD **33** every 1/30 seconds is subjected to the prescribed signal processing by the sequence from the A/D converter **26** to the γ correction circuit **29**, and stored in the image memory **34**. This pixel data is simultaneously transferred to the VRAM **49** via the general controller **43**, and displayed on the LCD display portion **24**. Whereby, the user can recognize the photographic object image on the LCD display portion **24**. In the reproduction mode, image read out from the memory card **18** is subjected to the prescribed signal processing by the general controller **43**, which is then transferred to the VRAM **49**, and displayed on the LCD display portion **24**.

The obtained image is also transmittable to an external monitor **53** via the VRAM **51** and the NTSC converting portion **52**.

A card I/F **48** is an interface for writing the image data into the memory card **18** or reading the image data from the memory card **18**. A communication I/F **44** is an interface based on, for example, the IEEE 1394, for externally connecting the digital camera **12** to personal computers or each network connecting devices **45**. The reference numeral **46** denotes a recording medium such as a floppy disk and a magneto-optical disk used for a personal computer **63**. The recording medium **46** is used to store the image sent from the digital camera **12**, or is storing a program to be installed into the digital camera **12**.

The operation portion **55** is constituted by the shutter start button **16**, the photographing mode setting keys **20**, the liquid crystal display panel **21**, the image-processing mode setting keys **23**, the LCD monitor **24** and the like.

The general control portion **43** comprises a microcomputer, and it organically controls the photographing operation of the digital camera **12**. The general control portion **43** is provided with a ROM **43**A as a recording medium storing the program for executing various processing including the area discrimination processing, the blur-control processing and the image-composing processing and the RAM **43**B as a recording medium used as a work area at the time of executing the processing.

The general control portion **43** has an image number counter for counting the number of picked-up images for the blur-control processing.

Next, the operation (photographing sequence) of the digital camera shown in FIGS. **16** to **18** will be explained with reference to the flowchart shown in FIGS. **19** to **20**.

In this embodiment, the technique of "area discrimination using the blur difference" is used for the discrimination between the main photographic object area and the background area. In this technique, the area is discriminated by comparing a plurality of images with different focal positions. The detail thereof is disclosed by the paper entitled "Enhanced Image Acquisition by Using Multiple Differently Focused Images" [written by Naito, Kodama, Aizawa and Hatori: Transactions of the Institute of Electronics, Information and Communication Engineers D-II. Vol.79-D-II No.6 pp. 1046–1053].

In **#401**, it is discriminated whether the shutter start button **16** is pressed. If not pressed (OFF in **#401**), the routine waits until it is pressed. When pressed (ON in **#401**), in **#402**, the general control portion **43** reads out and stores the setting of the photographing conditions and the image-processing mode at that time.

Subsequently, in **#403**, it is discriminated whether the blur-control mode is set as the image-processing mode. If the blur-control mode is set (On in **#403**), the routine proceeds to **#501** in FIG. **20**. If the blur-control mode is not set (OFF in **#403**), the functions of the area discrimination circuit **30**, the blur-control circuit **31**, the image composing circuit **32** and the filter operation circuit **33** are set as OFF in **#404**.

Then, in **#405**, the photographic object distance is measured by the distance measurement portion **37**. Subsequently, based on the distance measurement result, in **#406**, the image taking lens **14** is driven by driving the motor **42** (FIG. **18**) so that the photographic object is focused. In **#407**, the aperture-diaphragm is set to a suitable value via the aperture-diaphragm control driver **41** (FIG. **18**).

Then, in **#408**, the CCD **15** is integrated. In **#409**, the image data is read out. The read image data is converted into the digital data by the A/D converter **26**, and subjected to the predetermined processing by the black level correction circuit **27**, the WB circuit **28** and the γ correction circuit **29**. Thereafter, in **#401**, the data is stored in the media **18**, and the routine returns to **#401** for the next photographing.

In **#403**, if the blur-control mode is set (ON in **#403**), in **#501** shown in FIG. **20**, the photographic object distance is measured by the distance measurement portion **37** in the same manner as in the case where it is not set. Subsequently, in **#502**, the motor **42** is driven to drive the image taking lens **32** based on the distance measurement result so that the photographic object is focused. Furthermore, in **#503**, the aperture-diaphragm is set to a suitable value by the aperture-diaphragm control driver **41**.

Next, in **#504**, the CCD **15** is integrated. Then, in **#505**, the image data is read out. The read data is converted into the digital data by the A/D converter **26**, and then subjected to the prescribed processing by the black level correction circuit **27**, the WB circuit **28** and the γ correction circuit **29**. Thereafter, the data is temporarily stored in the image memory **34**.

Subsequently, in **#506**, it is checked whether the required number of images is obtained by the general control portion **43**. If not obtained (NO in **#506**), the routine returns to **#501**, and the image is obtained. However, the next image is focused on a photographic object other than the previously focused photographic objects.

If the required number of images is obtained in **#506** (YES in **#506**), in **#507**, the area discrimination is performed using the blur difference by the area discrimination circuit **30**.

Subsequently, in **#508**, blur-control processing is performed. Then, in **#509**, an image is composed. Since the pixel value of the main photographic object area in the blur-filter is removed in the blur-control processing, faults generated when the blur was added is removed. Accordingly, a good composite image can be obtained.

In addition, in cases where the obtained image looks something wrong at the boundary portion of the area to which the blur-filter operation was performed, in **#510**, the boundary portion is enlarged by several pixels in each direction toward the main photographic object area and the background area, and the enlarged area is subjected to the filter operation. The operation to be performed here is not necessary limited to the blur-filter operation. Any operation may be performed as long as it has an effect that softens the sense of incongruity in the boundary portion between the main photographic object area and the background area like the weighting mean value operation of the main photographic object area and the background area.

Thereafter, in **#511**, the obtained image is stored in the storing media **18** such as a memory card, and thereafter the routine returns to **#501** for the next photographing.

In the aforementioned embodiment, the digital camera **12** is provided with the area discrimination circuit **30**, the blur-control circuit **31** and the image composing circuit **32**, and the digital camera **12** performs from the obtaining of the image to composing thereof. However, the following structure may be employed in place of the above: a program for performing an area discrimination function, a blur-control-processing function, and an image composition function is stored in a recording medium **46**; the program is read by an external computer **45**, and an image taken by a digital camera or a scanner is inputted into this computer, and then the computer processes the image in accordance with the program.

In cases where the processing is performed by a computer, one example of the flow of processing becomes as shown in FIG. **21**. That is, in **#601** and **#602**, a first image and a second image different from the first image in focus state are read by the computer. Here, the photographed image is read via a recording medium such as a memory card. The image designated by an operator is read. Thereafter, the boundary portion filter data processing, the blur-control processing, the image-composing processing and the boundary portion filter data processing are performed in **#603**, **#604**, **#605** and **#606**, respectively. These area discrimination processing, blur-control processing, image-composing processing and boundary portion filter data processing are the same as each processing shown in **#507** to **#510** shown in FIG. **20**, respectively. The result of this processing is displayed or stored in a recording medium.

The terms and descriptions in this specification are used only for explanatory purposes and the present invention is not limited to these terms and descriptions. It should be appreciated that there are many modifications and substitutions without departing from the spirit and the scope of the present invention which is defined by the appended claims. A present invention permits any design-change, unless it deviates from the soul, if it is within the limits by which the claim was performed.

What is claimed is:

1. An image processing method, comprising the steps of:

obtaining an image in which a first area including a first image and a second area including a second image are discriminated; and

a control step for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said control step includes:

a step for assigning a pixel value of a pixel in said second area near said boundary at a periphery of said second image to said first area; and

a step for performing said blur control to said second image by using said filter.

2. The image processing method as recited in claim **1**, wherein said obtaining step includes a step for cutting out said first image from an entire image, and said method further comprising a step for composing the cut-out first image and the blur controlled second image.

3. The image processing method as recited in claim **1**, wherein said step of assigning said pixel values in said second area to said first area is performed along the boundary in a strip-shaped manner at predetermined intervals.

4. An image processing method, comprising the steps of:

obtaining an image in which a first area including a first image and a second area including a second image are discriminated; and

a control step for performing a blur control to a second image using a filter to obtain a blur-controlled second image while adjusting processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said control step includes a step for changing a configuration of said filter near said boundary corresponding to a contour of said second area.

5. The image processing method as recited in claim **4**, wherein said obtaining step includes a step for cutting out said first image from an entire image, and said method further comprising a step for composing the cut-out first image and the blur controlled second image.

6. An image processing method comprising:

obtaining an image in which a first area including a first image and a second area including a second image are discriminated and

a control step for performing a blur control to a second image using a filter to obtain a blur-controlled second image while adjusting processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said control step includes:

a step for arranging a pixel value of a pixel to be processed in place of a pixel value of a pixel not to be processed when said pixel not to be processed is included within a range of said filter; and

a step for performing said blur control to said second image in said second area by using said filter.

7. An image processing apparatus, comprising:

a processor for obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other; and

a blur controller for performing a blur control to a second image using a filter to obtain a blur-controlled second image while adjusting processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said blur controller performs said blur control to said second image by using said filter after associating a pixel value of a pixel in said second area near said boundary at a periphery of said second image with said first area.

8. The image processing apparatus as recited in claim **7**, wherein said processor cuts out said first image from said entire image and composes the cut-out first image and the blur controlled second image.

9. The image processing method as recited in claim **7**, wherein associating said pixel values in said second area with said first area is performed along the boundary in a strip-shaped manner at predetermined intervals.

10. An image processing apparatus comprising:

a processor for obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other; and

a blur controller for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said blur controller performs said blur control to said second image by using said filter while changing a configuration of said filter near said boundary corresponding to a contour of said second area.

11. The image processing apparatus as recited in claim **10**, wherein said processor cuts out said first image from said entire image and composes the cut-out first image and the blur controlled second image.

12. An image processing apparatus comprising:

a processor for obtaining an image in which a first area including a first image and a second area including a second image are discriminated with each other; and

a blur controller for performing a blur control to a second image using a filter to obtain a blur-controlled second image while accompanying processing for reducing an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said blur controller performs said blur control to said second image by using said filter after arranging a pixel value of a pixel to be processed in place of a pixel value of a pixel not to be processed when said pixel not to be processed is included within a range of said filter.

13. A computer readable program embodied in a computer readable medium for attaining the following functions:

obtaining an image in which a first area having a first image and a second area having a second image are discriminated with each other; and

performing a blur control to a second image using a filter to obtain a blur-controlled second image while altering the processing to reduce an influence of said first area at a boundary between said first area and said second area and therearound when said blur control is performed to said second image, wherein said performing a blur control includes:

arranging a pixel value of a pixel to be processed in place of a pixel value of a pixel not to be processed when said pixel not to be processed is included within a range of said filter; and

performing said blur control to said second image in said second area by using said filter.

14. The computer readable program as recited in claim **13**, wherein said processing to reduce an influence of said first area is performed by associating a pixel value of a pixel in said second area near said boundary at a periphery of said second image with said first area.

15. The computer readable program as recited in claim **14**, wherein said first image is cut out from an entire image, and the cut-out first image and the blur controlled second image are composed.

16. The image processing method as recited in claim **14**, wherein said step of associating said pixel values in said second area with said first area is performed along the boundary in a strip-shaped manner at predetermined intervals.

17. The computer readable program as recited in claim **13**, wherein said first image is cut out from an entire image, and the cut-out first image and the blur controlled second image are composed.

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